DEVELOPING A STATE WATER PLAN

GROUND WATER CONDITIONS IN UTAH, SPRING OF 1978

COOPERATIVE INVESTIGATIONS REPORT NO 17

UTAH DIVISION OF WATER RESOURCES — U.S. GEOLOGICAL SURVEY

DEVELOPING A STATE WATER PLAN

GROUND–WATER CONDITIONS IN UTAH, SPRING OF 1978

by

Joseph S. Gates and others

United States Geological Survey

Prepared by the United States Geological Survey
in cooperation with the State of Utah

Published by
Division of Water Resources
Utah Department of Natural Resources

Cooperative Investigations Report Number 17

1978

CONTENTS

ILLUSTRATIONS

ILLUSTRATIONS – Continued

TABLES

U.S. CUSTOMARY–TO–METRIC CONVERSION FACTORS

Most values are given in this report in U.S. customary units followed by metric units in parentheses. The conversion factors used are shown to four significant figures. However, in the text the metric equivalents are shown only to the number of significant figures consistent with the accuracy of the value in U.S. customary units.

U.S. customary			Metric	
Units (Multiply)	Abbreviation	(by)	Units (to obtain)	Abbreviation
Acre-foot	acre-ft	0.001233	Cubic hectometer	hm^3
Foot	ft	.3048	Meter	m
Inch	in.	25.40	Millimeter	mm
Mile	mi	1.609	Kilometer	km
Square mile	mi^2	2.590	Square kilometer	km^2

Chemical concentration is given only in metric units––milligrams per liter (mg/L). For concentrations less than 7,000 mg/L, the numerical value is about the same as for concentrations in the U.S. customary unit, parts per million.

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INTRODUCTION

This report is the fifteenth in a series of annual reports that describe ground-water conditions in Utah. Reports in the series, prepared cooperatively by the U.S. Geological Survey and the Utah Division of Water Resources, provide data to enable interested parties to keep abreast of changing ground-water conditions.

This report, like the others (see References, p. 13), contains information on well construction, ground-water withdrawals, water-level changes, and related changes in precipitation and streamflow. Supplementary data such as graphs showing chemical quality of water and maps showing water-table configuration are included in reports of this series only for those years or areas for which applicable data are available and are important to a discussion of changing ground-water conditions.

The report includes individual discussions of selected major areas of ground-water withdrawal in the State for the calendar year 1977. Water-level fluctuations, however, are described for the period spring 1977 to spring 1978. Much of the data used in the report were collected by the Geological Survey in cooperation with the Division of Water Rights, Utah Department of Natural Resources.

The following reports dealing with ground water in the State were released by the Geological Survey during 1977:

A digital model of ground-water flow in Spanish Valley, Grand and San Juan Counties, Utah, by J. H. Eychaner, U.S. Geological Survey Open-File Report 77-760.

Ground-water resources of the Parowan-Cedar City drainage basin, Iron County, Utah, by L. J. Bjorklund, C. T. Sumsion, and G. W. Sandberg, Utah Department of Natural Resources Technical Publication 60 (in press).

Hydrologic reconnaissance of the Dugway Valley-Government Creek area, west-central Utah, by J. C. Stephens and C. T. Sumsion, Utah Department of Natural Resources Technical Publication 59.

Hydrology of the Beaver Valley area, Beaver County, Utah, with emphasis on ground water, by R. W. Mower, Utah Department of Natural Resources Technical Publication 63 (in press).

Hydrology and surface morphology of the Bonneville Salt Flats and Pilot Valley playa, Utah, by G. C. Lines, U.S. Geological Survey Open-File Report 78-18 (pending publication as a U.S. Geological Survey Water-Supply Paper).

Selected ground-water data, Bonneville Salt Flats and Pilot Valley, western Utah, by G. C. Lines, U.S. Geological Survey open-file report (duplicated as Utah Basic-Data Release 30).

Selected hydrologic data, Parowan Valley and Cedar City Valley drainage basins, Iron County, Utah, by L. J. Bjorklund, C. T. Sumsion, and G. W. Sandberg, U.S. Geological Survey open-file report (duplicated as Utah Basic-Data Release 28).

Subsurface-temperature data for some wells in western Utah, by F. E. Rush, U.S. Geological Survey Open-File Report 77-132.

Summary appraisal of the nation's ground-water resources——Great Basin Region, by T. E. Eakin, Don Price, and J. R. Harrill, U.S. Geological Survey Professional Paper 813-G.

Water resources of the northern Uinta Basin area, Utah and Colorado, with emphasis on ground-water supply, by J. W. Hood and F. K. Fields, Utah Department of Natural Resources Technical Publication 62 (in press).

Selected hydrologic data, Wasatch Plateau-Book Cliffs coal-fields area, Utah, by K. M. Waddell and others, U.S. Geological Survey Open-File Report 78-126 (in press).

Ground-water conditions in the Navajo Sandstone, central Virgin River basin, Utah, by R. M. Cordova, Utah Department of Natural Resources Technical Publication 61 (in press).

Climatologic and hydrologic data, southeastern Uinta Basin, Utah and Colorado, water years 1975 and 1976, by L. S. Conroy, and F. K. Fields, U.S. Geological Survey open-file report (duplicated as Utah Basic-Data Release 29).

Map showing general chemical quality of ground water in the Kaiparowits coal-basin area, Utah, by Don Price, U.S. Geological Survey Miscellaneous Investigations Map I-1033-A.

Map showing general availability of ground water in the Kaiparowits coal-basin area, Utah, by Don Price, U.S. Geological Survey Miscellaneous Investigations Map I-1033-B.

UTAH'S GROUND–WATER RESERVOIRS

Small quantities of ground water can be obtained from wells throughout much of Utah, but large supplies that are of suitable chemical quality for irrigation, public supply, or industrial use generally can be obtained only in specific areas. The major areas of ground-water development discussed in this report are shown in figure 1 and named in table 1. Only a few wells outside of these areas yield large supplies of water of good chemical quality for the uses listed above, although some of the basins in western Utah and many areas in eastern Utah have not been explored sufficiently to determine their potential for ground-water development.

About 2 percent of the wells in Utah obtain water from consolidated rocks. The consolidated rocks that yield the most water are lava flows, such as basalt, which contain interconnected vesicular openings or fractures; limestone, which contains fractures or other openings enlarged by solution; and sandstone, which contains interconnected openings between the grains that form the rock and may also contain open fractures. Most of the wells that tap consolidated rocks are in the eastern and southern parts of the State in areas where water supplies cannot be obtained readily from unconsolidated rocks.

About 98 percent of the wells in Utah draw water from unconsolidated rocks. These rocks may consist of boulders, gravel, sand, silt, or clay, or a mixture of some or all of these sizes. Wells obtain the largest yields from the coarser materials that are sorted into deposits of uniform grain size. Most wells that tap unconsolidated rocks are in large intermountain basins, which have been partly filled with debris from the adjacent mountains.

SUMMARY OF CONDITIONS

The estimated total withdrawal of water from wells in Utah in 1977 was about 947,000 acre-feet (1,170 hm^3), which is about 86,000 acre-feet (110 hm^3) and 10 percent more than in 1976 and 210,000 acre-feet (260 hm^3) and 28 percent greater than the average annual withdrawal during 1967-76 (table 2). Both the increase over 1976 and the increase over the 10-year average were due primarily to increases in withdrawals for irrigation and public supply.

Total withdrawal for irrigation in 1977 was about 676,000 acre-feet (834 hm^3), which is about 68,000 acre-feet (84 hm^3) more than in 1976 (table 2). Irrigation withdrawals in most major areas of ground-water development were greater in 1977 than in 1976. Slight decreases, however, in irrigation withdrawals were reported in the East Shore and Milford areas and in Tooele, Juab, and Parowan Valleys.

The quantities of water withdrawn from wells for irrigation are closely related to local climatic conditions. Precipitation in 1977 was below average in most of Utah, especially during the early part of the year (National Oceanic and Atmospheric Administration, 1978). Of the 33 stations for which graphs of cumulative departure from average annual precipitation are included in this report, 25 had below-average precipitation in 1977. Taken together, all 33 stations were 10 percent below average in 1977. The drought was even more pronounced in the southern half of the State. The precipitation at the 15 stations which are south of Nephi was 23 percent below average in 1977. The drought was most intense during October 1976-April 1977, which is the period of the year when snow falls in the mountainous areas of the State and collects to furnish water for streamflow and ground-water recharge in the following spring and summer. The precipitation at the 27 stations included in this report for which a 1941-70 normal precipitation can be calculated were all below normal and averaged 62 percent below normal during October 1976-April 1977. Precipitation for the October 1977-April 1978 period generally was above normal, but reservoirs contained about 96 percent of their average usable contents on April 1, 1978, down from about 114 percent on April 1, 1977, because of the drought.

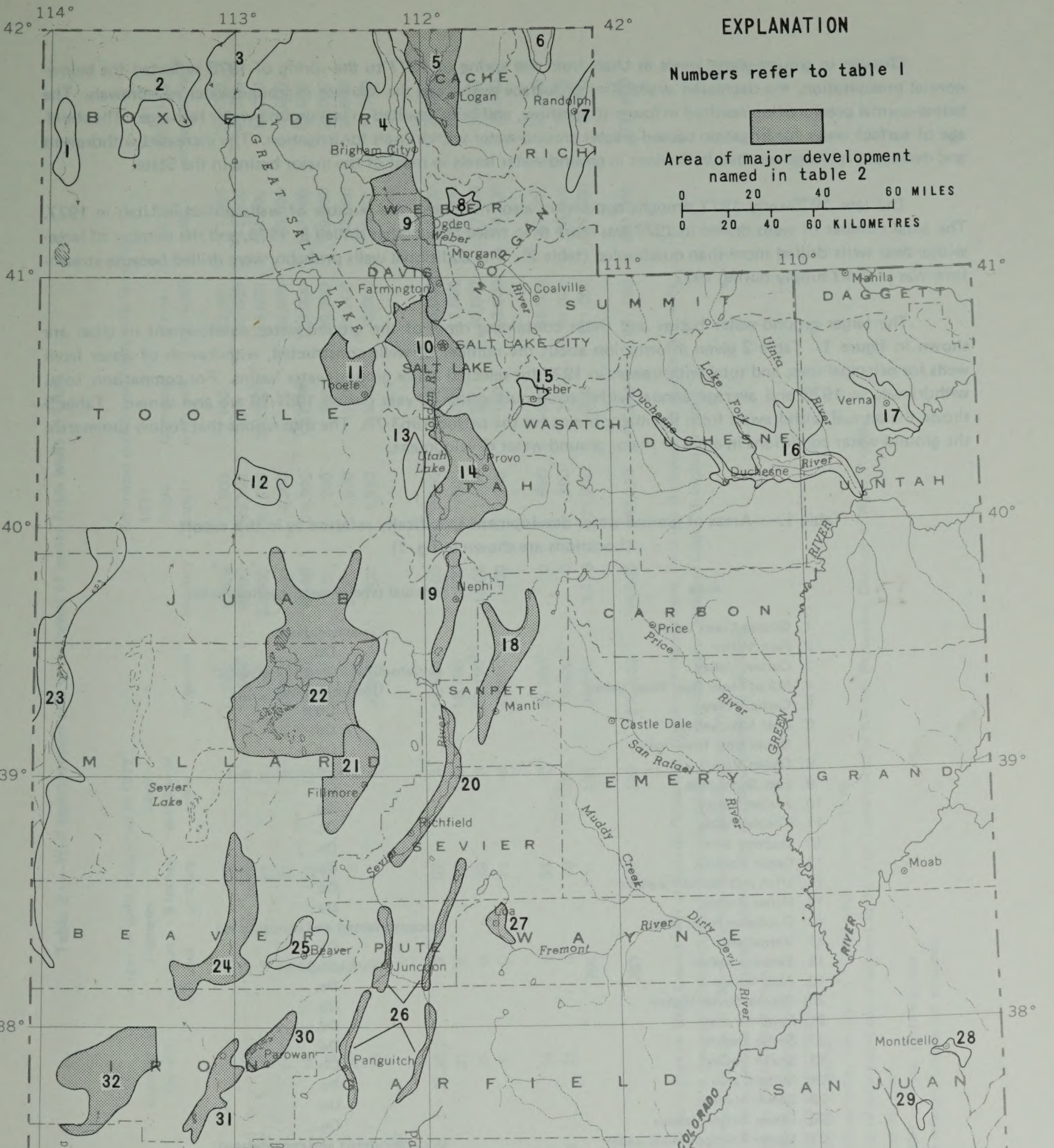

Figure 1.—Areas of ground-water development specifically referred to in this report.

Changes in ground-water levels in Utah from the spring of 1977 to the spring of 1978 reflected the below-normal precipitation, the decreased availability of surface water, and the increase in ground-water withdrawals. The below-normal precipitation resulted in lower streamflow, and both resulted in less ground-water recharge. The shortage of surface water for irrigation caused greater ground-water withdrawals for irrigation. The increased withdrawals and decreased recharge resulted in declines in ground-water levels in most of the major basins in the State.

The late 1976-early 1977 drought apparently also influenced the number of wells drilled in Utah in 1977. The total number of wells drilled in 1977 was more than twice the number drilled in 1976, and the number of large-withdrawal wells drilled more than quadrupled (table 2). The additional wells probably were drilled because streamflow was in short supply during 1977.

The larger ground-water basins and those containing most of the ground-water development in Utah are shown in figure 1. Table 2 given information about the number of wells constructed, withdrawals of water from wells for principal uses, and total withdrawals in 1977 for selected major ground-water basins. For comparison, total withdrawals in 1976 and average annual withdrawals during the 10-year period 1967-76 are also shown. Table 3 shows the annual withdrawals from the major basins for the period 1963-77. The discussions that follow summarize the ground-water conditions in areas of major ground-water development.

Table 1.——Areas of ground-water development specifically referred to in this report
(Locations are shown in fig. 1)

Area	Principal type of water-bearing rocks
1. Grouse Creek valley	Unconsolidated
2. Park Valley	Do.
3. Curlew Valley	Unconsolidated and consolidated
4. Malad-lower Bear River valley	Unconsolidated
5. Cache Valley	Do.
6. Bear Lake valley	Do.
7. Upper Bear River valley	Do.
8. Ogden Valley	Do.
9. East Shore area	Do.
10. Jordan Valley	Do.
11. Tooele Valley	Do.
12. Dugway area	Do.
13. Cedar Valley	Do.
14. Utah and Goshen Valleys	Do.
15. Heber Valley	Do.
16. Duchesne River area	Unconsolidated and consolidated
17. Vernal area	Do.
18. Sanpete Valley	Unconsolidated
19. Juab Valley	Do.
20. Central Sevier Valley	Do.
21. Pavant Valley	Do.
22. Sevier Desert	Do.
23. Snake Valley	Do.
24. Milford area	Do.
25. Beaver Valley	Do.
26. Upper Sevier Valleys	Do.
27. Upper Fremont River valley	Unconsolidated and consolidated
28. Monticello area	Unconsolidated
29. Blanding area	Do.
30. Parowan Valley	Unconsolidated and consolidated
31. Cedar City Valley	Unconsolidated
32. Beryl-Enterprise area	Do.
33. Central Virgin River area	Unconsolidated and consolidated

Table 2.––Well construction and withdrawal of water from wells in Utah

Area	Number in figure 1	Number of wells completed in 1977[1]: Diameter: Less than 6 inches	Diameter: 6 inches or more	Large-withdrawal wells[2]	Estimated withdrawal from wells (acre-ft): 1977: Irrigation	Industry	Public supply	Domestic and stock	Total (rounded)	1976 total[3]	1967-76 average annual[4]
Cache Valley	5	29	35	4	17,600	8,800[5]	3,800	2,100	32,000	27,000	24,000
East Shore area	9	35	20	5	15,800[6]	6,700	29,300	-	52,000	41,000	43,000
Jordan Valley	10	9	97	24	5,500	33,000[7]	47,300	33,000[5]	119,000	124,000	117,000
Tooele Valley	11	1	27	6	23,200[6]	500	4,300	150	28,000	30,000	27,000
Utah and Goshen Valleys	14	25	153	13	66,800	8,100	30,300	12,700[8]	118,000	107,000	89,000
Juab Valley	19	0	10	3	28,500	50	200	200	29,000	29,000	23,000
Sevier Desert	22	4	19	0	46,800	2,000	600	900	50,000	33,000	26,000
Sanpete Valley	18	0	17	4	30,900	900	1,300	3,300[8]	36,000	25,000	17,000
Upper and central Sevier and upper Fremont River Valleys[9]	26,20,27	0	57	4	16,500	100	2,800	6,300	26,000	25,000	20,000
Pavant Valley	21	0	19	6	115,700	100	600	300	117,000	95,000	83,000
Cedar City Valley	31	0	19	8	37,100[10]	1,000	1,900	200	40,000	37,000	32,000
Parowan Valley	30	0	11	6	32,800[10,11]	100	250	150	33,000	34,000	26,000
Escalante Valley											
Milford area	24	0	23	12	64,000[12]	0	800	200	65,000	67,000	57,000
Beryl-Enterprise area	32	0	20	12	79,500[10]	0	300	750	81,000	79,000	78,000
Other areas[13]		280	701	181	94,800	3,100	21,900	1,200	121,000	108,000	75,000
Totals (rounded)		383	1,228	288	676,000	64,000	146,000	61,000	947,000	861,000	737,000

[1] Compiled from data supplied by Utah Department of Natural Resources, Division of Water Rights. Includes deepened and replacement wells.
[2] Wells (6 inches or more in diameter) constructed for irrigation, industry, or public supply. Included under "6 inches or more."
[3] From Bolke and others (1977, p. 6). Some figures include unpublished revisions.
[4] Calculated from previous reports of this series. Some figures include unpublished revisions.
[5] Includes some use for fish and fur culture.
[6] Includes some domestic and stock use.
[7] Includes some use for air conditioning.
[8] Includes some use for irrigation.
[9] Upper Fremont River valley included in "Other areas" prior to 1976.
[10] Data from reports of local water commissioners to the Utah Department of Natural Resources, Division of Water Rights.
[11] Includes some use for stock.
[12] Data from the Milford Water Commissioner.
[13] Withdrawals are estimated minimum amounts.

Table 3.—–Withdrawal of water from wells during 1963-77 in major areas of ground-water development in Utah

(Thousands of acre-feet)

Area	Number in figure 1	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	Totals
Cache Valley	11	27	29	28	33	24	22	26	25	24	23	24	24	25	27	32	393
East Shore area[1]	9	36	55	59	55	53	46	38	39	41	41	42	50	41	41	52	689
Jordan Valley	10	111	110	102	126	103	107	109	109	116	124	129	130	122	124	119	1,741
Tooele Valley	22	25	21	20	25	21	22	23	25	24	29	29	33	29	30	28	384
Utah and Goshen Valleys	29	86	75	73	98	80	74	78	83	86	91	89	106	98	107	118	1,342
Juab Valley	30	21	19	18	25	21	17	18	18	21	30	17	31	25	29	29	339
Sevier Desert	26	26	31	27	31	32	29	21	16	17	40	22	25	26	33	50	426
Sanpete Valley	31	13	16	12	21	15	13	15	14	16	20	16	17	15	25	36	264
Upper and central Sevier and upper Fremont River Valleys[2]	32,33	20	18	18	20	19	19	20	19	19	19	19	20	24	25	26	305
Pavant Valley	51	80	72	69	88	77	63	75	71	79	99	69	101	98	95	117	1,253
Cedar City Valley[3]	42	22	22	16	25	26	30	27	31	36	35	27	42	28	37	40	444
Parowan Valley[3]	43	14	16	15	20	18	22	20	26	24	28	26	31	28	34	33	355
Escalante Valley																	
Milford area[4]	40	42	46	46	52	46	49	52	56	58	59	52	70	60	67	65	820
Beryl-Enterprise area[3]	39	64	72	70	79	71	74	84	70	75	77	74	93	85	79	81	1,148
Other areas[5]		8	43	38	45	41	48	56	72	75	80	79	106	85	108	121	1,005
Totals (rounded)		600	640	610	740	650	640	660	670	710	800	710	880	790	860	950	10,910

[1] Discharge from flowing wells estimated by well count prior to 1969 and by changes in artesion pressure from 1969 through 1977.

[2] Upper Fremont River valley included in other areas prior to 1976.

[3] Beginning in 1968, withdrawals for irrigation have been obtained from reports of local water commissioners to the Utah Department of Natural Resources, Division of Water Rights.

[4] Beginning in 1968, withdrawals for irrigation have been obtained from the Milford Water Commissioner.

[5] Estimated minimum amounts; includes only Beaver and Cedar Valleys in 1963.

MAJOR AREAS OF GROUND–WATER DEVELOPMENT

CACHE VALLEY

by W. N. Jibson

Total discharge from wells in Cache Valley in 1977 was about 32,000 acre-feet (39 hm^3). This was an increase of 5,000 acre-feet (6 hm^3) over the amount reported for 1976 and 8,000 acre-feet (10 hm^3) more than the 1967-76 annual average. Withdrawal for irrigation increased nearly 50 percent over that reported for 1976 due to deficient supplies of surface water for irrigation. Discharge of the Logan River during 1977 was 77,700 acre-feet (96 hm^3), only 46 percent of the discharge in 1976 and 43 percent of the 1941-75 average. This discharge is the lowest of the period of record which began in 1896. In contrast to irrigation pumpage, withdrawal for public supply decreased about 8 percent due to a large increase in the use of spring water by the city of Logan.

Water levels in most of Cache Valley declined from March 1977 to March 1978 (fig. 2), owing to increased withdrawal for irrigation and for public supply in the smaller communities. Declines up to about 6 feet (1.8 m) were measured in the east-central part of the valley. Rises up to about 3 feet (0.9 m) were measured in the north end of the valley and a rise of about 6 feet (1.8 m) was measured in a well in the Clarkston area.

The long-term trend of the water level in well (A-12-1)29cab-1, the annual discharge of the Logan River near Logan, and the cumulative departure from the average annual precipitation at Logan Utah State University are shown for comparison in figure 3. In contrast to the deficient streamflow, annual precipitation was 2.43 inches (62 mm) higher than the 1941-75 average. This was due chiefly to a record storm in the Logan area on August 18 and 19, which had little effect on the annual discharge of the Logan River or the water level in well (A-12-1)29cab-1.

EAST SHORE AREA

by L. R. Herbert

The withdrawal of water from wells in the East Shore area in 1977 was about 52,000 acre-feet (64 hm^3), 11,000 acre-feet (14 hm^3) more than reported for 1976 and 9,000 acre-feet (11 hm^3) more than the 1967-76 annual average (table 2). About 56 percent of the water used in 1977 was for public supply. Withdrawals for irrigation decreased slightly because of a decrease in discharge from flowing wells used for irrigation.

Water levels declined in virtually all the East Shore area from March 1977 to March 1978 (fig. 4). The largest declines, more than 10 feet (3 m), were a result of withdrawals of large amounts of ground water for public supply in the Bountiful, Layton-Hill Air Force Base-Roy, and North Ogden areas.

The long-term relation between water levels in selected wells and precipitation at Ogden Pioneer powerhouse is shown in figure 5. Annual precipitation for 1977 was 2.62 inches (67 mm) below the 1937-75 average of 20.85 inches (530 mm). Below-average precipitation for two consecutive years resulted in less surface water and increased use of ground water. The resulting decline of water levels from March 1976 to March 1978 is reflected in the hydrographs of all four observation wells.

JORDAN VALLEY

by R. W. Mower

The withdrawal of water from wells in Jordan Valley in 1977 was 119,000 acre-feet (147 hm^3), 5,000 acre-feet (6 hm^3) less than the amount reported for 1976 (fig. 6) but 2,000 acre-feet (2.5 hm^3) more than the annual average reported for the previous 10-year period, 1967-76 (table 2). Withdrawals in 1977 for irrigation increased moderately because below-average precipitation in the valley's watershed diminished surface-water supplies. However, withdrawals for public supply, domestic and stock uses, and industry were slightly lower than 1976, chiefly because of the efforts to conserve water during the drought of 1976-77 and because some industrial wells were not operating during most of the year.

According to figure 7, water levels declined from February 1977 to February 1978 in about 90 percent of Jordan Valley and rose in about 10 percent; the average change in water level in the valley was a decline of about 2.5 feet (0.8 m). The largest observed decline was 18 feet (5.5 m) in a well about 2 miles (3.2 km) southwest of Riverton. Water levels rose a maximum of 8.5 feet (2.6 m) in a well near the southwest corner of Salt Lake City. The maximum declines were due to pumping for irrigation where surface-water supplies were much smaller than normal. The rises were mainly due to less pumping from public-supply wells in 1977 than in 1976.

The relation between fluctuations of water levels in selected wells and precipitation is illustrated in figure 8. Precipitation at Silver Lake Brighton during 1977 was 0.59 inch (15 mm) below the average for 1931-75. The below-average precipitation resulted in below-average streamflow and recharge and locally in increased pumping, which are reflected in declines of water levels at four of the five observation wells.

TOOELE VALLEY

by A. C. Razem

During 1977 approximately 28,000 acre-feet (35 hm^3) of water was withdrawn from wells in Tooele Valley. This amount is 2,000 acre-feet (2.5 hm^3) less than reported for 1976 and 1,000 acre-feet (1.2 hm^3) more than the average annual withdrawal for the previous 10 years, 1967-76 (table 2). The decrease in withdrawals was due to more precipitation during the growing season in 1977 than in 1976, and possibly to reduction in pumpage because of higher energy costs.

The discharge from springs in 1977 was approximately 17,000 acre-feet (21 hm^3), which is 4,000 acre-feet (4.9 hm^3) less than reported for 1976. The difference is attributed to improved measuring techniques rather than an actual decrease in discharge. About 3,400 acre-feet (4.2 hm^3) of the spring discharge was used for irrigation and stock in the valley, and about 13,600 acre feet (16.8 hm^3) was diverted to Jordan Valley for industrial use.

Water levels rose in the northern part of the valley, while declines occurred in the Erda and Grantsville areas due to below-average precipitation and pumping for irrigation (fig. 9). Declines of more than 4 feet (1.2 m) occurred south of Grantsville and declines of more than 3 feet (0.9 m) occurred south of Erda. Water levels rose up to about 2 feet (0.6 m) in the northern part of the valley where there are few pumping wells. Water levels rose in part of the valley even though 1977 precipitation was below average, probably because 1977 precipitation was significantly higher than that of 1976.

The relation between water levels in selected wells and precipitation at Tooele is shown in figure 10. Of the six wells measured in 1977 and 1978, water levels declined in two and rose in four. Precipitation at Tooele in 1977 was about 96 percent of the 1936-75 average.

UTAH AND GOSHEN VALLEYS

by R. M. Cordova

Withdrawal of water from wells in Utah and Goshen Valleys in 1977 was about 118,000 acre-feet (145 hm^3), which is the largest annual withdrawal of record for those areas. This withdrawal is 11,000 acre-feet (13.6 hm^3) more than reported for 1976 and 29,000 acre-feet (36 hm^3) more than the 1967-76 average. Withdrawals for public supply and irrigation in 1977 were significantly more than in 1976--11,700 and 4,700 acre-feet (14.4 and 5.8 hm^3), respectively. Industrial use was 5,200 acre-feet (6.4 hm^3) less than in 1976 because U.S. Steel Corp (by far the largest industrial user) opted to use a greater proportion of surface water in its operations. In Utah Valley, 96,700 acre-feet (119 hm^3) was withdrawn in 1977, or about 9,300 acre-feet (11.5 hm^3) more than in 1976; in Goshen Valley, 21,300 acre-feet (26.3 hm^3) was withdrawn in 1977, or about 2,000 acre-feet (2.5 hm^3) more than in 1976.

Water levels in most observation wells declined from March 1977 to March 1978 (figs. 11-15). The general decline resulted from the large increase in ground-water withdrawal in 1977. The increased need for ground water was mainly a result of (1) a fast-growing population and (2) a significant decline of spring flow (on the order of 10 to 70 percent), which resulted from generally below-normal precipitation during 1976 and 1977 (fig. 15). Spring flow is a principal source of public supply and also maintains streamflow during much of the irrigation season.

The water-level rise in the water-table aquifers in Goshen Valley and near American Fork (fig. 11) was probably the result of recharge from above-normal precipitation during the first 3 months of 1978; the recharge was large enough to overbalance the increased well discharge in 1977 and occurred where these aquifers are permeable at the land surface.

JUAB VALLEY

by V. L. Jensen

The withdrawal of water from wells in Juab Valley during 1977 was about 29,000 acre-feet (36 hm^3), the same as reported for 1976 and 6,000 acre-feet (7.4 hm^3) more than the 1967-76 average (table 2). The increase in withdrawals was due to decreased availability of surface water for irrigation.

Water levels declined from March 1977 to March 1978 in almost all Juab Valley (fig. 16), owing to below-average precipitation and withdrawals of ground water in excess of recharge.

The relation between water levels in two selected wells and the cumulative departure from the 1935-75 average annual precipitation at Nephi is shown in figure 17. Water levels declined in both wells; precipitation at Nephi for 1977 was 2.95 inches (75 mm) below the 1935-75 average.

SEVIER DESERT

by R. W. Mower

The withdrawal of water from wells in the Sevier Desert in 1977 was about 50,000 acre-feet (62 hm^3), which was 17,000 acre-feet (21 hm^3) more than was reported for 1976 and about 24,000 acre-feet (30 hm^3) more than the average annual withdrawal for the previous 10 years, 1967-76 (table 2). The increase from 1976 to 1977 was due chiefly to withdrawals for irrigation of land for which surface-water supplies were insufficient. During 1977, discharge of the Sevier River near Juab was about 106,000 acre-feet (131 hm^3) (fig. 20). This was about 53,000 acre-feet (65 hm^3) less than the 1976 discharge (33 percent less) and about 35,000 acre-feet (43.2 hm^3) less than the average discharge for 1935-75 (25 percent less).

In those parts of the Sevier Desert in which there are observation wells, water levels declined from March 1977 to March 1978 in the lower artesian aquifer and in 88 percent of the upper artesian aquifer (figs. 18 and 19). The largest observed water-level decline in the lower aquifer was 13.2 feet (4.0 m) about 1 mile (1.6 km) north of Oak City. The largest observed decline in the upper artesian aquifer was 7.5 feet (2.3 m) about 2 miles (3.2 km) north of Oak City. Water levels rose less than 1 foot (0.3 m) in the upper artesian aquifer in local areas in the west-central and northwestern parts of the Sevier Desert.

The long-term relations between precipitation at Oak City, discharge of the Sevier River near Juab, and water levels in selected wells are shown in figure 20. Precipitation at Oak City in 1977 was 3.51 inches (89 mm) below the 1935-75 average. The water levels declined in all three observation wells from March 1977 to March 1978 because of increased withdrawals of ground water and less recharge due to below-average precipitation and streamflow.

SANPETE VALLEY

by M. D. ReMillard

Approximately 36,000 acre-feet (44 hm^3) of water was withdrawn from wells in Sanpete Valley during 1977, which was 11,000 acre-feet (14 hm^3) more than the amount withdrawn in 1976 and 19,000 acre-feet (23 hm^3) more than the average annual withdrawal for the period 1967-76 (table 2). Withdrawal of water from irrigation wells during 1977 was much more than in 1976 due to below-average precipitation and streamflow. Because the amount of surface water available for irrigation was below average, more ground water was pumped.

Water levels declined in most of Sanpete Valley from March 1977 to March 1978 (fig. 21). Declines were measured of more than 12 feet (3.6 m) around Ephraim and more than 6 feet (1.8 m) around Mount Pleasant and at the southern end of the valley. The declines were due mainly to large withdrawals of ground water for irrigation and reduced recharge because of below-average precipitation and streamflow.

Long-term hydrographs of water levels in three wells in Sanpete Valley and the long-term trend of precipitation at Manti are shown in figure 22. Precipitation was below average after 1973, and the water-level declines in the three wells since 1974-75 reflect the decreased precipitation and increased use of ground water throughout the area.

UPPER AND CENTRAL SEVIER AND UPPER FREMONT RIVER VALLEYS

by D. C. Emett

The withdrawal of water from wells in the upper and central Sevier River valleys and upper Fremont River valley was about 26,000 acre-feet (32 hm^3) in 1977. This was 1,000 acre-feet (1.2 hm^3) more than in 1976 and 6,000 acre-feet (7.4 hm^3) more than the 1967-76 annual average (table 2).

Water levels rose in seven observation wells and declined in 25 wells from March 1977 to March 1978 (fig. 23). Water levels in two of the observation wells declined until the wells were dry. The largest observed rise, 6.6 feet (2.0 m), occurred in well (C-36-3)6dba-1 north of Rubys Inn and was probably caused by recharge from the East Fork Sevier River. The largest observed decline, 8.6 feet (2.6 m), occurred in well (D-28-3)16bdb-1 east of Loa and was probably caused by pumping and decreased recharge because of below-average precipitation and streamflow.

The relation of water levels in selected wells to discharge of the Sevier River at Hatch and precipitation at Panguitch, Salina, and Loa is shown in figure 24. Precipitation was below average at all three stations. Discharge of the Sevier River at Hatch, 28,360 acre-feet (35 hm^3), was about 47,000 acre-feet (58 hm^3) less than the 1940-75 average and was the lowest of record.

PAVANT VALLEY

by C. T. Sumsion

Withdrawal of water from wells in Pavant Valley in 1977 was 117,000 acre-feet (144 hm^3), which was 22,000 acre-feet (27 hm^3) more than reported for 1976 and 34,000 acre-feet (42 hm^3) more than the 1967-76 annual average (table 2.) The increase in withdrawals was because precipitation was less than average in 1977 and less surface water was available for irrigation.

Water levels declined throughout most of the valley (fig. 25) because of pumping for irrigation and below-average precipitation. The largest measured decline was 24.0 feet (7.3 m) in a well about 3 miles (4.8 km) southwest of Fillmore. The largest measured rise was 3.1 feet (0.94 m) in a well about 3 miles (4.8 km) northwest of Holden.

The relation of water levels in selected wells to ground-water withdrawals and cumulative departure from the 1931-75 average precipitation at Fillmore is shown in figure 26. Water levels declined in six of the observation wells and rose in one well. Precipitation was about 31 percent less than average in 1977.

Some of the water pumped for irrigation in Pavant Valley percolates back to the valley's aquifers as recharge and is withdrawn again for irrigation. Such recirculation of ground water affects its chemical quality (Handy and others, 1969, p. D228-D234); consequently, the general trend since 1957 has been an increased concentration of dissolved solids in water from all wells at which data have been collected (fig. 27). The concentration of dissolved solids in 1977 compared to the most recent preceding measurement was greater in wells (C-19-4)31dbb-1 and (C-21-5)7cdd-3, the same in wells (C-23-5)5acd-1 and (C-23-6)21bdd-1, and less in well (C-23-6)8abd-1.

CEDAR CITY VALLEY

by P. A. Carroll

Approximately 40,000 acre-feet (49 hm^3) of water was pumped from wells in Cedar City Valley during 1977. This was 3,000 acre-feet (3.7 hm^3) more than was pumped in 1976 and 8,000 acre-feet (10 hm^3) more than the average annual withdrawal for the previous 10 years, 1967-76 (table 2). The increased pumpage was for irrigation.

Water levels declined throughout the valley in response to pumping except in one small area about 8 miles (13 km) north of Cedar City (fig. 28). The largest declines, more than 7 feet (2.1 m), were northwest of Cedar City, and they reflect the increased pumping and the decreased ground-water recharge due to below-average precipitation and discharge of Coal Creek.

Figure 29 shows annual pumpage in Cedar City Valley, annual discharge of Coal Creek, departure from average precipitation at Cedar City, and water levels in well (C-35-11)33aac-1. Below-average precipitation caused decreased streamflow, which in turn decreased the amount of surface water available for irrigation. More ground water was pumped to offset the lack of surface water, which resulted in the near-record pumpage and caused water levels to decline. The water level in well (C-35-11)33aac-1 in October 1977 was the lowest of record. Discharge of Coal Creek for 1977 also was the lowest of record.

PAROWAN VALLEY

by M. J. DeGrand

Approximately 33,000 acre-feet (41 hm^3) of water was withdrawn from wells in Parowan Valley in 1977, a decrease of 1,000 acre-feet (1.2 hm^3) from 1976 and 7,000 acre-feet (8.6 hm^3) more than the average annual withdrawal for the previous 10 years, 1967-76 (table 2). The increase over the 10-year average was due to the general increase in pumping for irrigation (table 2).

Water levels declined in almost the entire valley between March 1977 and March 1978. Declines ranged from less than 1 foot (0.3 m) in the southwestern and northeastern parts of the valley to more than 10 feet (3 m) in two small areas in the center of the valley (fig. 30). The general decline of water levels results from withdrawal of ground water.

The relations between water levels in well (C-34-8)5bca-1, average annual pumpage from Parowan Valley, and precipitation at Parowan Airport are shown in figure 31. Water levels declined in 1977 for the fourth consecutive year as a result of heavy pumping for irrigation. Below-average precipitation during the growing season probably resulted in more pumping; and below-average precipitation for the year also resulted in less surface water for irrigation, which in turn resulted in above average ground-water withdrawal and less recharge.

ESCALANTE VALLEY

Milford area

by R. W. Mower

The withdrawal of water from wells in the Milford area in 1977 was about 65,000 acre-feet (80 hm^3)--2,000 acre-feet (2.5 hm^3) less than was reported for 1976 and 8,000 acre-feet (10 hm^3) more than the average annual withdrawal for the previous 10 years, 1967-76 (table 2). The decrease from 1976 to 1977 was due to a decrease in withdrawal for irrigation, even though less surface water was available than in 1976. During 1977 the discharge of the Beaver River at Rocky Ford Dam near Minersville was about 11,700 acre-feet (14.4 hm^3)--24 percent less than during 1976 and 54 percent less than the annual average for 1932-75. Precipitation during 1977 at Milford Airport was 0.69 inch (18 mm) less than during 1976 and 1.13 inches (29 mm) less than the average annual for 1932-75 (fig. 33). About 73 percent of the precipitation occurred in 3 months of the growing season, which, together with the increased use of water-conserving sprinkler-irrigation systems, was largely the reason withdrawals for irrigation in 1977 were less than in 1976.

Water levels declined from March 1977 to March 1978 in 97 percent of the area covered by the observation-well network (fig. 32). The average change in water level in the area was a decline of 0.7 foot (0.2 m). The largest observed decline was almost 6 feet (1.8 m) in a well about 7 miles (11 km) south of Milford. The only observed rise--less than 1 foot (0.3 m)--was in a well in the southern most part of the area. The major declines from March 1977 to March 1978 were due largely to reduced recharge from canals and fields irrigated with surface water and perhaps to local above-average withdrawals for irrigation. In the small area where water levels rose, withdrawals did not increase, and recharge may have been greater than normal due to locally heavy summer storms.

The relations between water levels in well (C-29-10)6ddc-2 near the middle of the pumped area, precipitation at Milford Airport, discharge of the Beaver River, and ground-water withdrawals are shown in figure 33. The general decline of water levels related to below-average precipitation and decreased availability of surface water is illustrated by the water-level decline in well (C-29-10)6ddc-2. In addition, use of sprinkler-irrigation systems may have reduced recharge from irrigation water and caused part of the water-level declines.

ESCALANTE VALLEY

Beryl-Enterprise area

by G. W. Sandberg

The withdrawal of water from wells in the Beryl-Enterprise area in 1977 was about 81,000 acre-feet (100 hm^3), an increase of about 2,000 acre-feet (2.5 hm^3) from the amount reported in 1976 and 3,000 acre-feet (3.7 hm^3) more than the average annual withdrawal for the previous 10 years, 1967-76 (table 2). The increase from 1976 to 1977 was due mostly to increased pumping for irrigation.

Water levels declined throughout the area except locally near Enterprise in the northeastern part (fig. 34). The largest declines, northeast of Enterprise and around Newcastle, were probably caused by locally heavy pumping in the areas and less than normal recharge, resulting from below-average precipitation. Declines in the central part of the area were about the same as in the previous year.

The long-term relations between water levels in selected wells, precipitation, and pumpage for irrigation are shown in figure 35. The water-level decline in well (C-35-17)25dcd-1 was slightly more in 1977 than in 1976.

Figure 36 shows changes in concentration of dissolved solids in the water from three wells. The concentration remained about the same in wells (C-34-16)28dcc-2 and (C-36-16)5a-9 and decreased slightly in well (C-37-17)12bdc-1. The slight decrease in dissolved solids may be because a smaller proportion of recharge is irrigation water. More water-conserving sprinkler systems have been used in the last few years, which likely has decreased recharge from irrigation.

OTHER AREAS

by L. R. Herbert

Approximately 121,000 acre-feet (149 hm^3) of water was withdrawn from wells in areas of Utah outside the major developed ground-water basins, which was 13,000 acre-feet (16 hm^3) more than the amount reported for 1976 and 46,000 acre-feet (57 hm^3) more than the 1967-76 annual average (table 2). The increase in withdrawals from wells in 1977 was due to the below-average precipitation, which decreased surface-water supplies for irrigation and other uses. This resulted in increased demands on ground-water supplies, chiefly for irrigation.

Estimated total withdrawals of water in 1977 from wells in areas of Utah other than the ground-water basins described in the preceding sections were as follows:

Area (see fig. 1)	Estimated withdrawal (acre-feet)
1. Grouse Creek valley	3,300
2. Park Valley	3,300
3. Curlew Valley	29,400
8. Ogden Valley	9,300
12. Dugway area (including Skull Valley north of area outlined in fig. 1)	5,800
13. Cedar Valley	3,100
23. Snake Valley	18,000
25. Beaver Valley	12,300
33. Central Virgin River area	17,500
Remainder of State	19,000
Total (rounded)	121,000

Figure 37 shows the relation between long-term hydrographs of observation wells in selected areas to the cumulative departure from average annual precipitation at sites in or near those areas. Water levels declined in most of the wells from March 1977 to March 1978. The declines were the result of locally large withdrawals of ground water and decreased recharge because of below-average precipitation and streamflow. Water levels rose in a few wells in areas where demands on ground water were slight or where recharge was larger than in 1976.

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ILLUSTRATIONS

On all maps showing changes in water levels, areas of water-level rise are indicated by dotted patterns, and areas of water-level decline are indicated by lined patterns

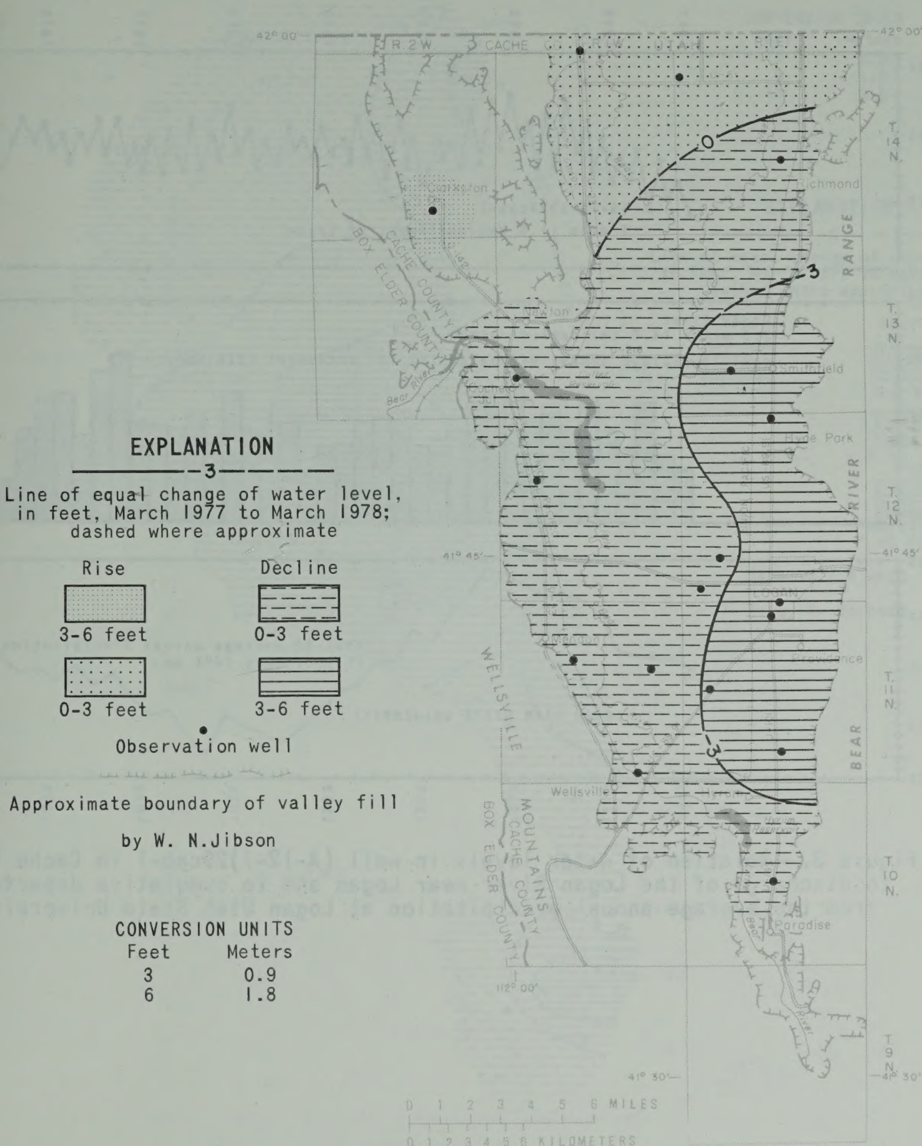


Figure 2.—Map of Cache Valley showing change of water levels from March 1977 to March 1978.

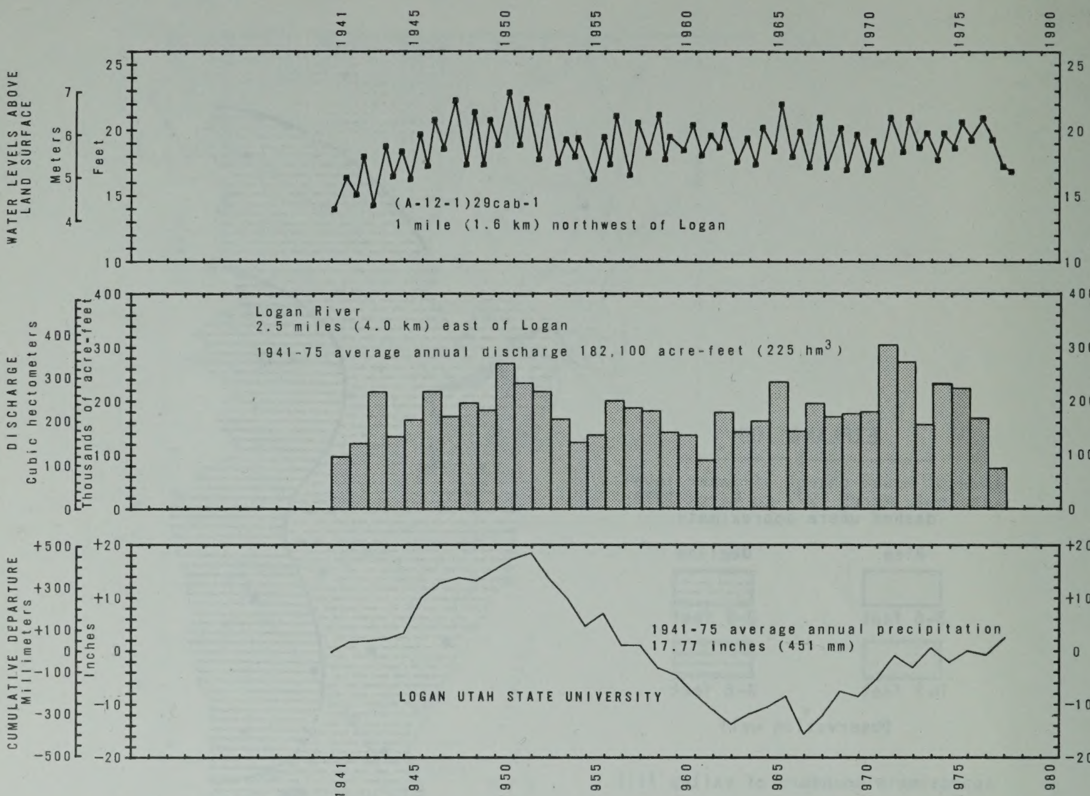


Figure 3.—Relation of water levels in well (A-12-1)29cab-1 in Cache Valley to discharge of the Logan River near Logan and to cumulative departure from the average annual precipitation at Logan Utah State University.

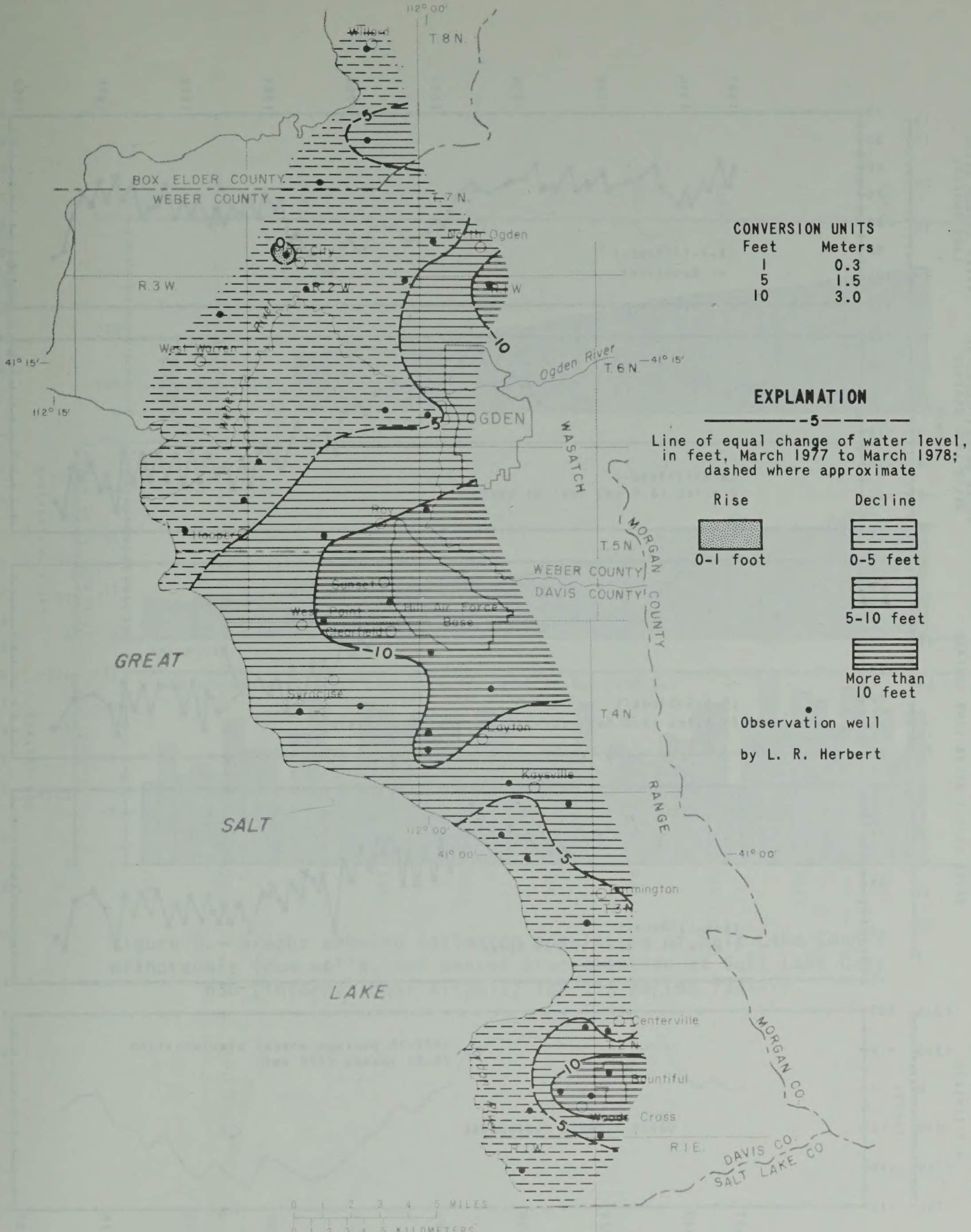


Figure 4.—Map of the East Shore area showing change of water levels from March 1977 to March 1978.

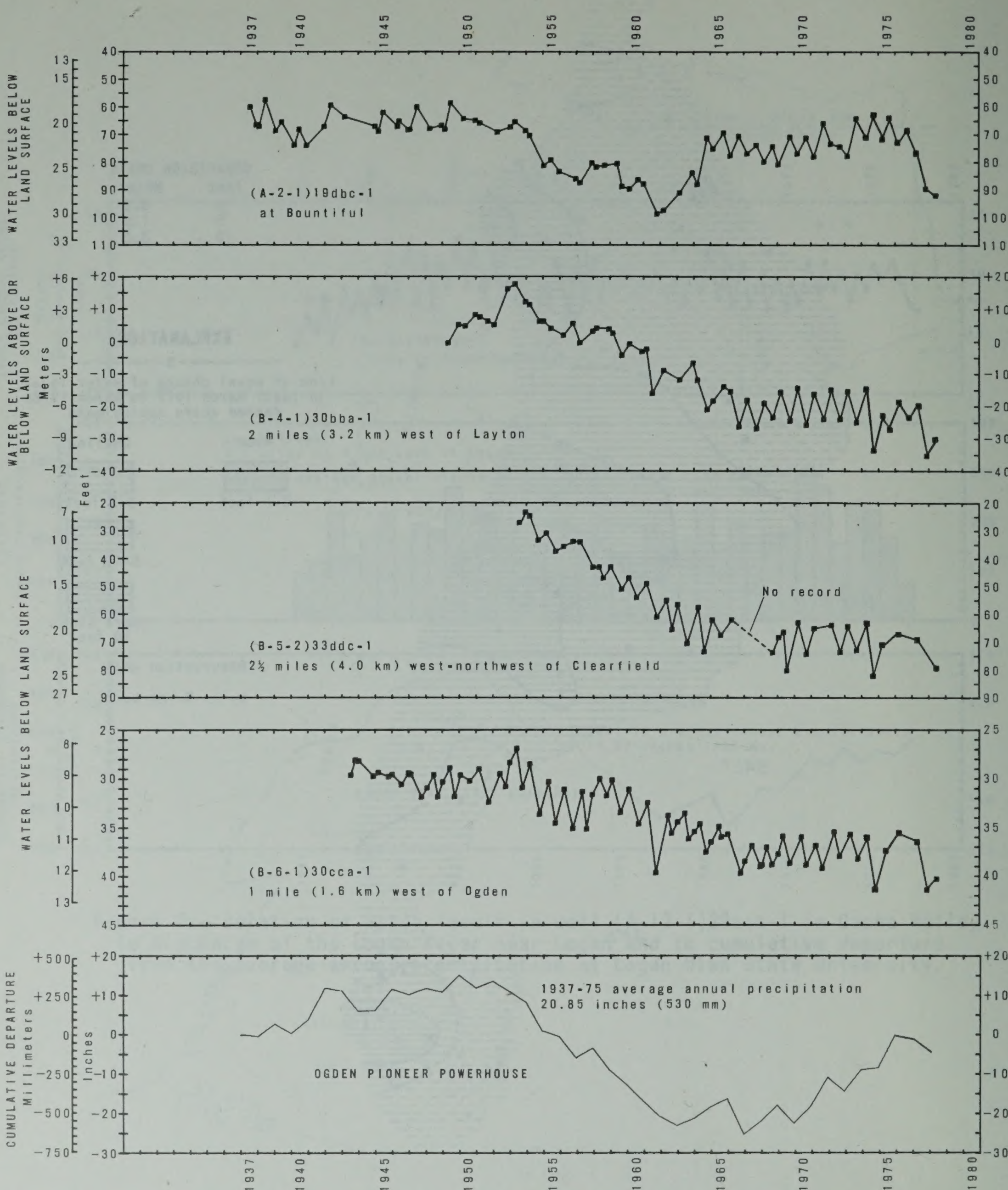


Figure 5.—Relation of water levels in selected wells in the East Shore area to cumulative departure from the average annual precipitation at Ogden Pioneer powerhouse.

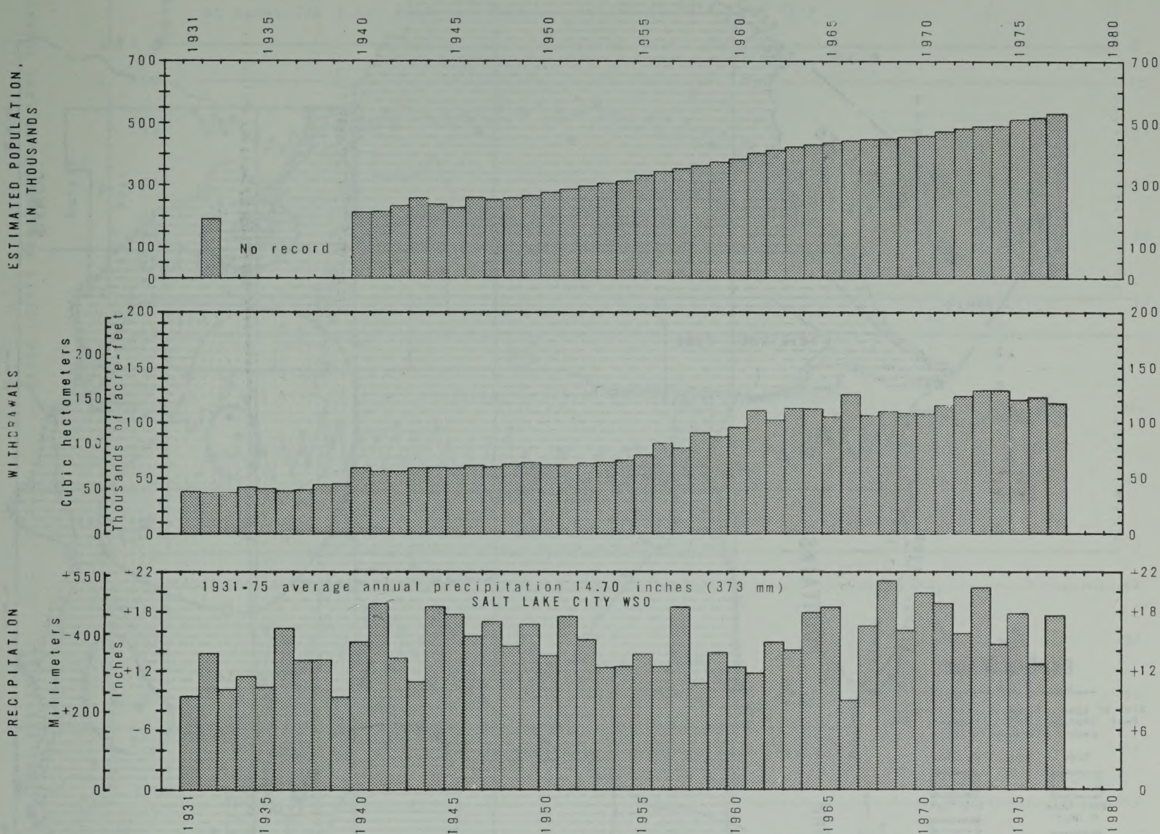


Figure 6.—Graphs showing estimated population of Salt Lake County, withdrawals from wells, and annual precipitation at Salt Lake City WSO (International Airport) for the period 1931-77.

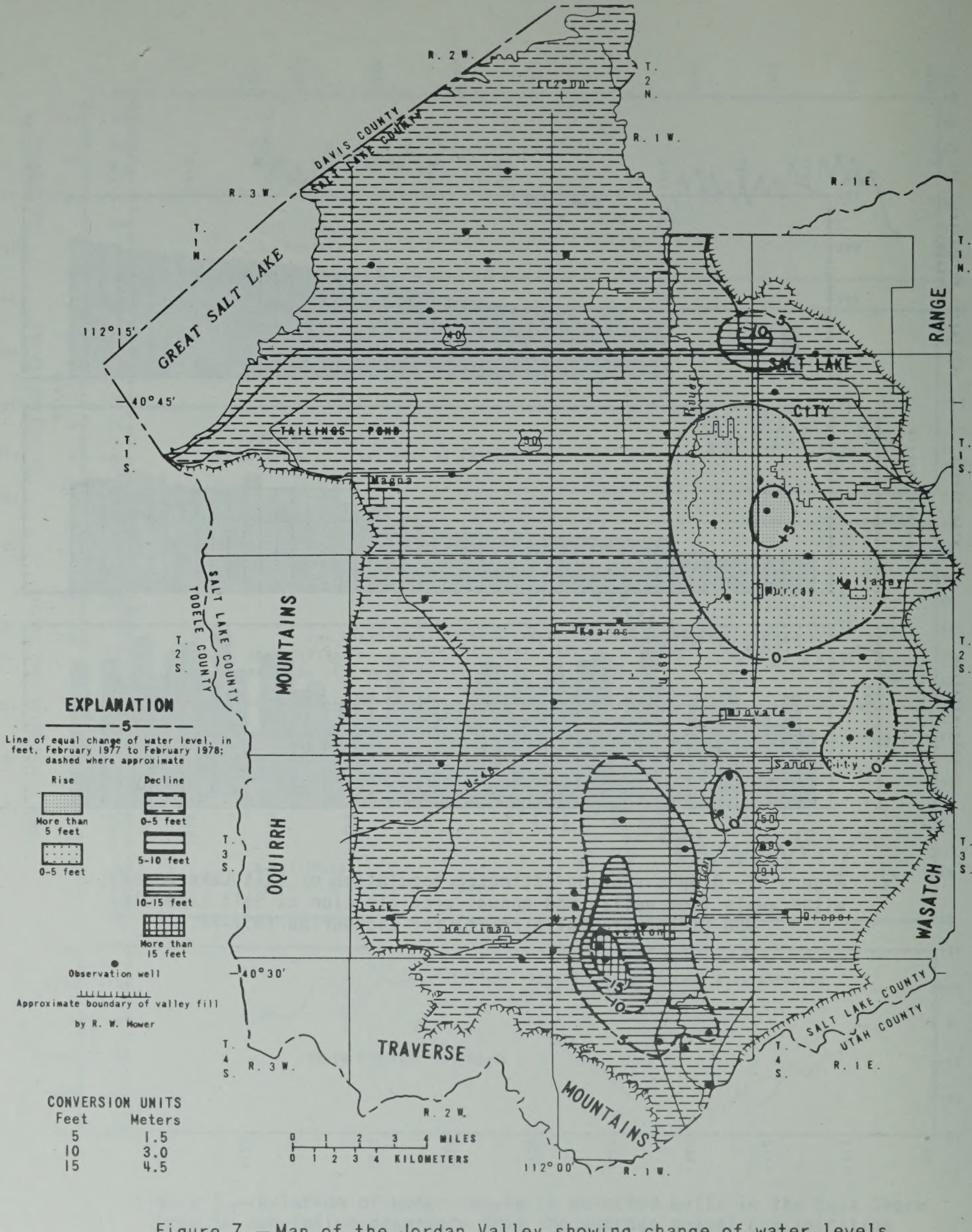


Figure 7.—Map of the Jordan Valley showing change of water levels from February 1977 to February 1978.

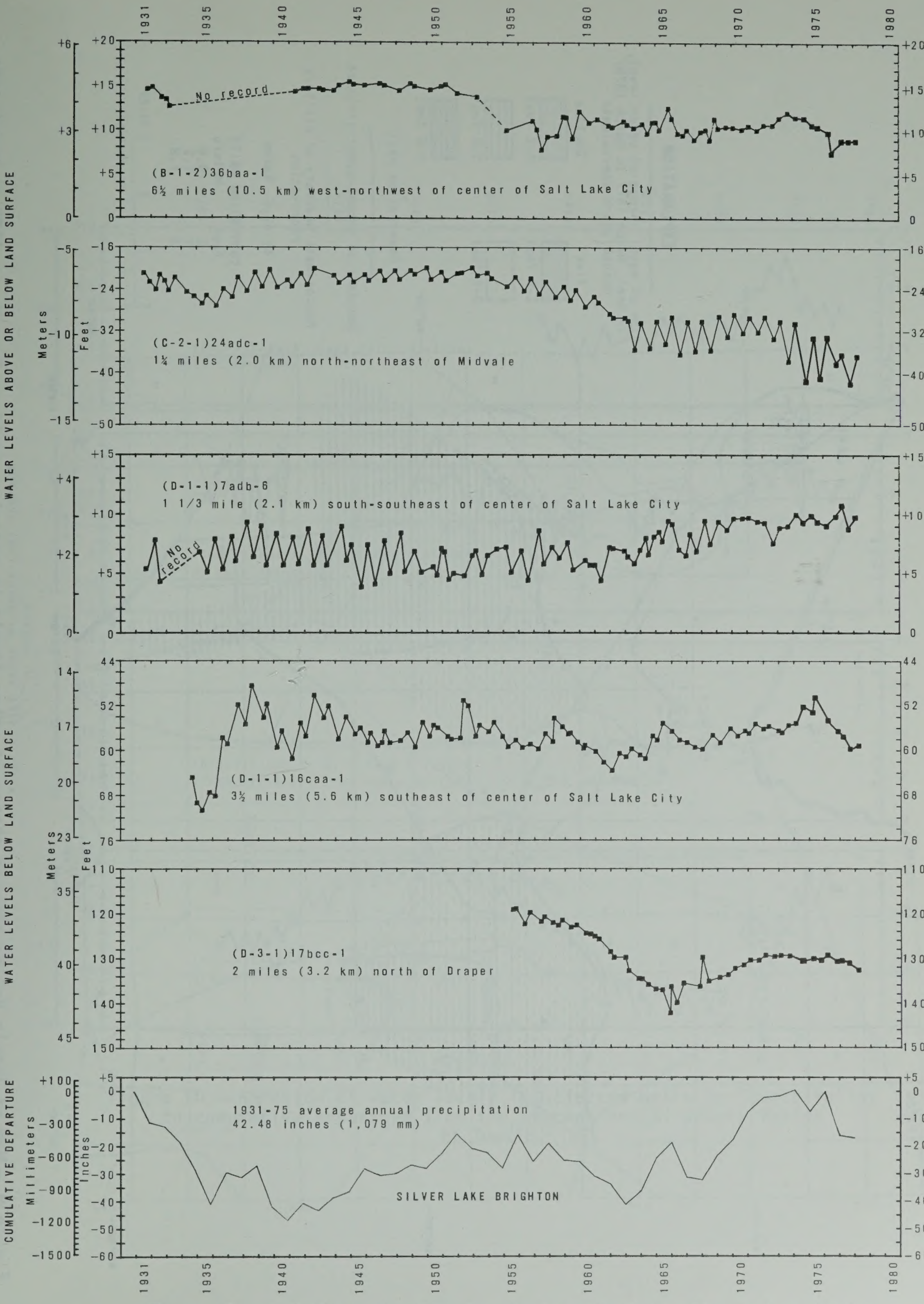


Figure 8.—Relation of water levels in selected wells in the Jordan Valley to cumulative departure from the average annual precipitation at Silver Lake Brighton.

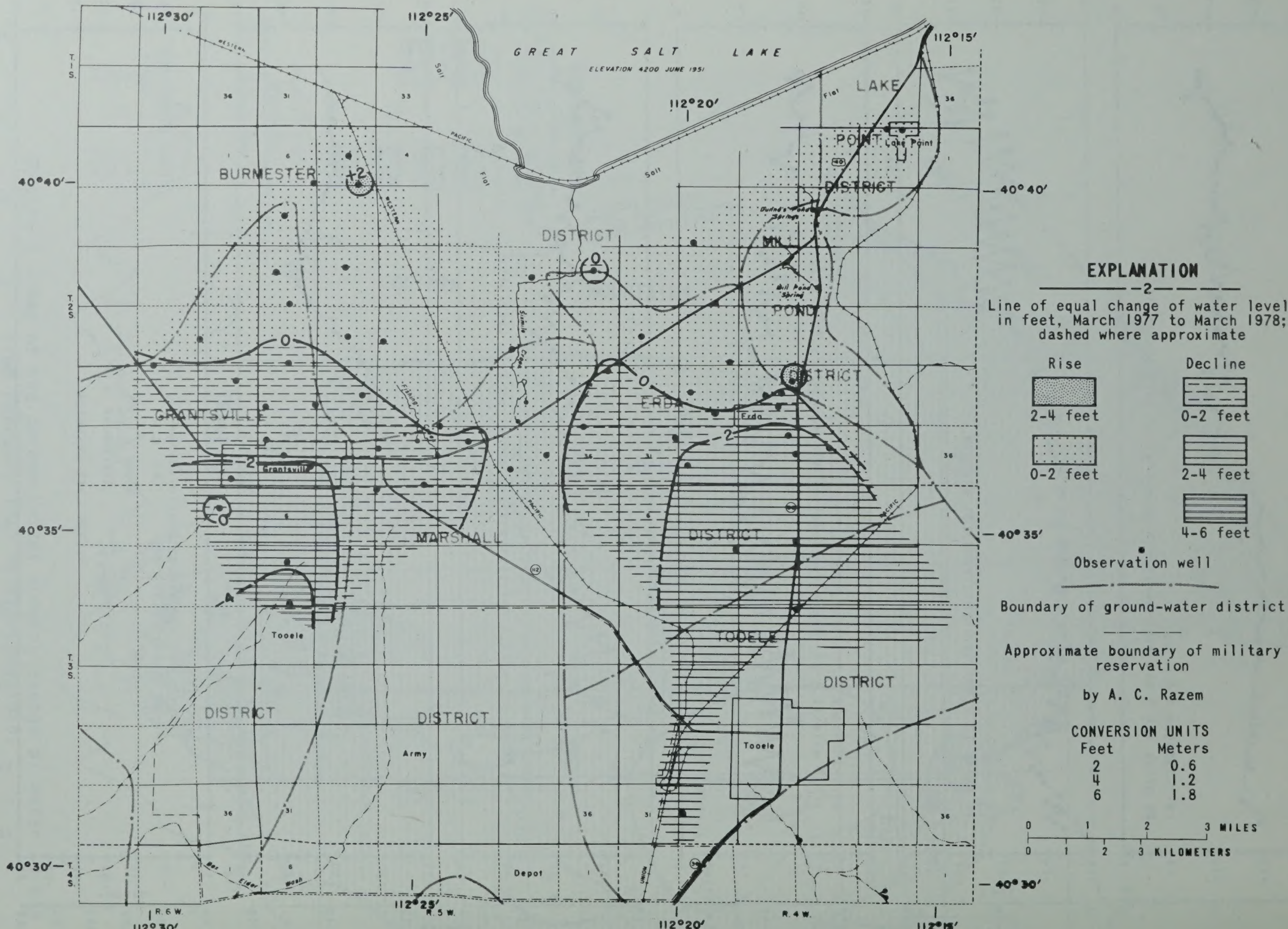


Figure 9.—Map of Tooele Valley showing change of water levels in artesian aquifers from March 1977 to March 1978.

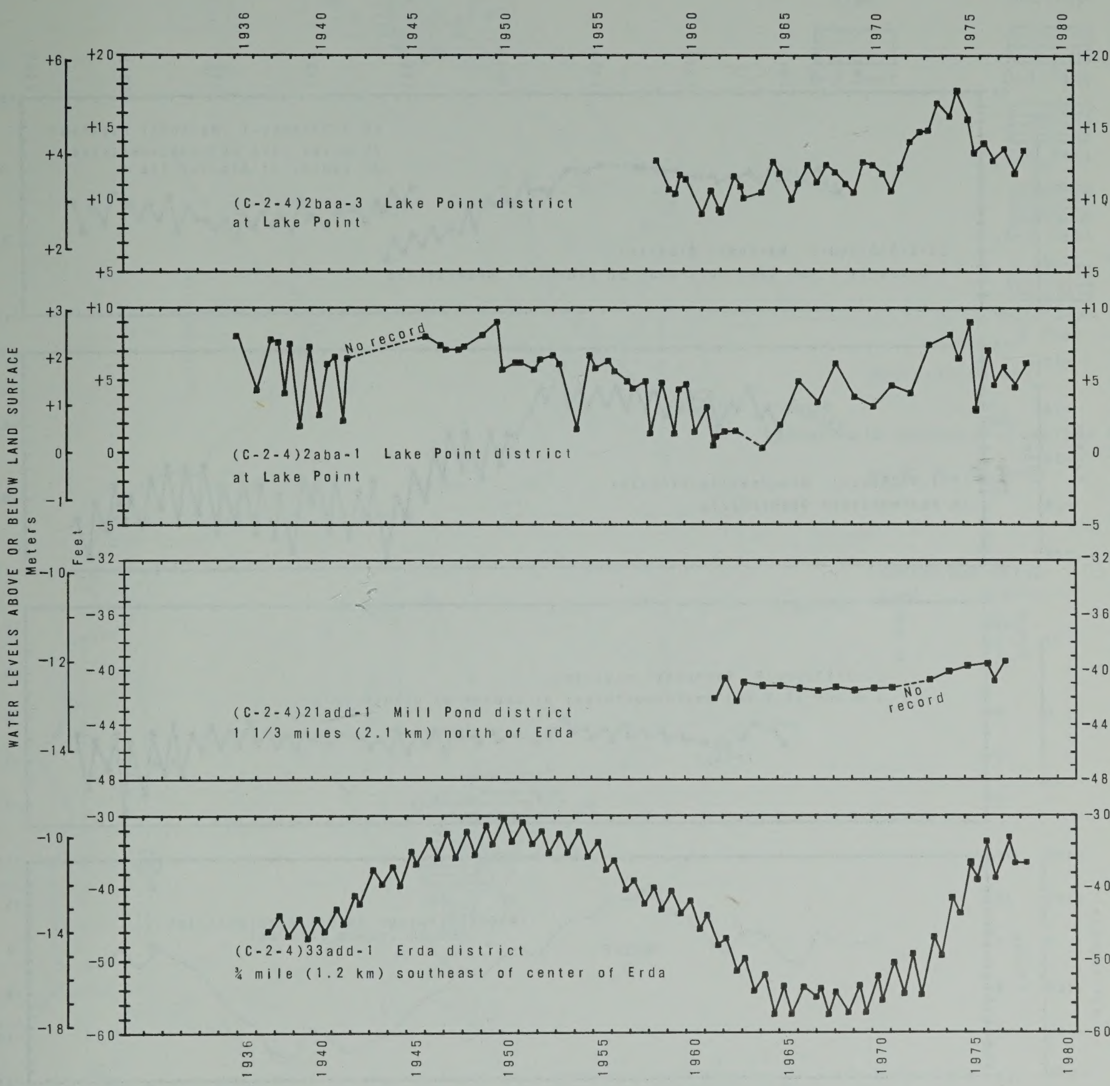


Figure 10.—Relation of water levels in selected wells in Tooele Valley to cumulative departure from the average annual precipitation at Tooele.

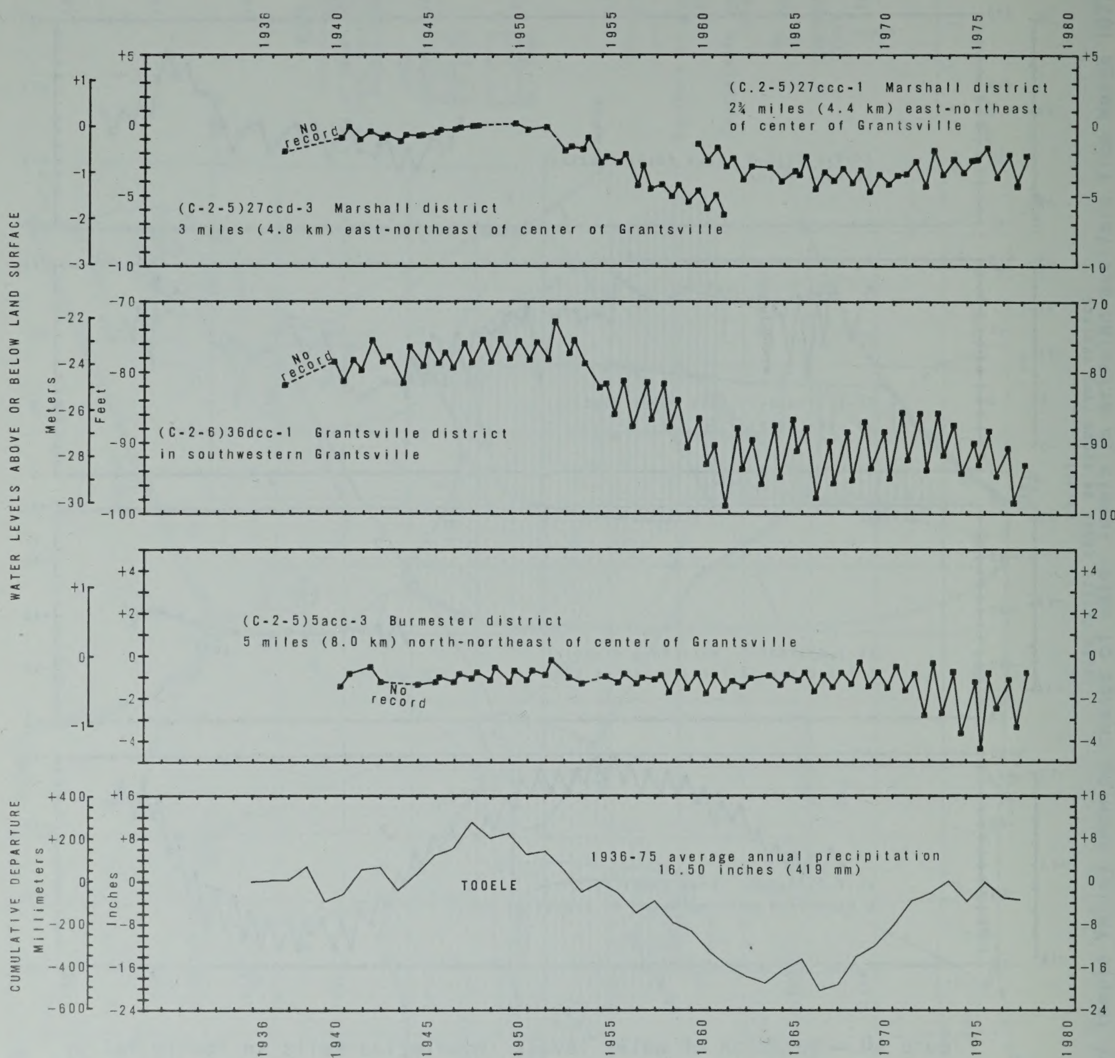


Figure 10.— Continued.

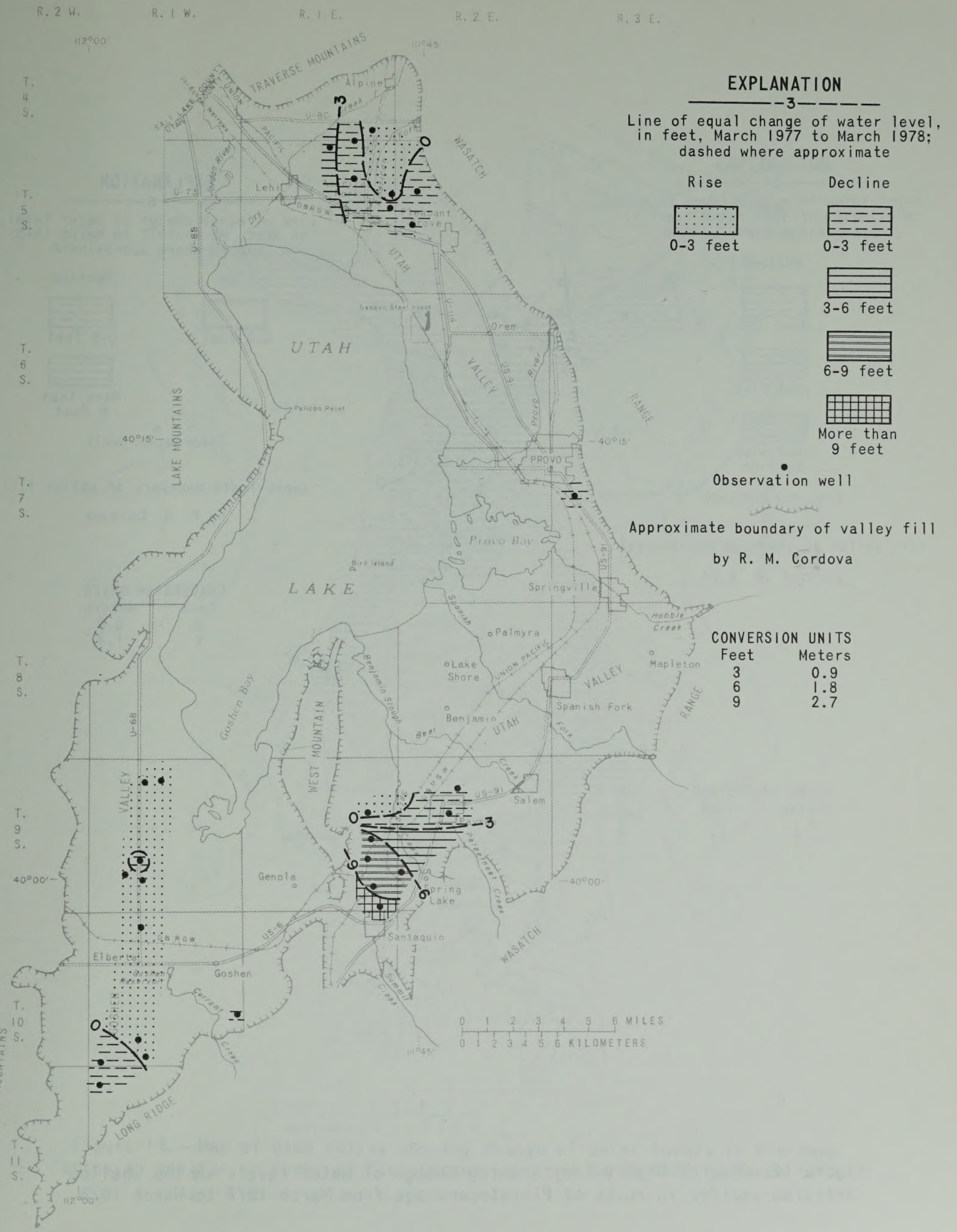


Figure 11.—Map of Utah and Goshen Valleys showing change of water levels in the water-table aquifers from March 1977 to March 1978.

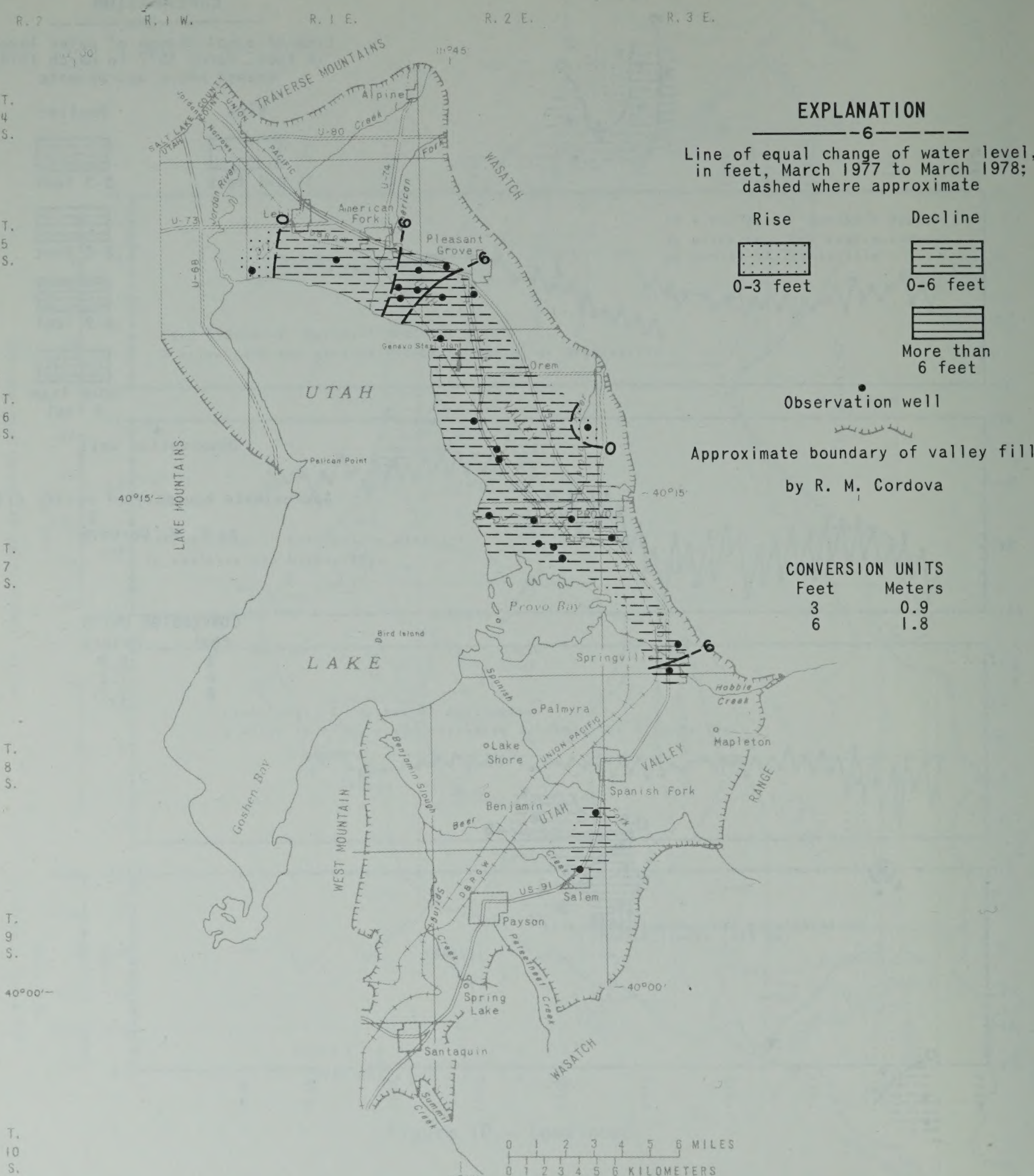


Figure 12.—Map of Utah Valley showing change of water levels in the shallow artesian aquifer in rocks of Pleistocene age from March 1977 to March 1978.

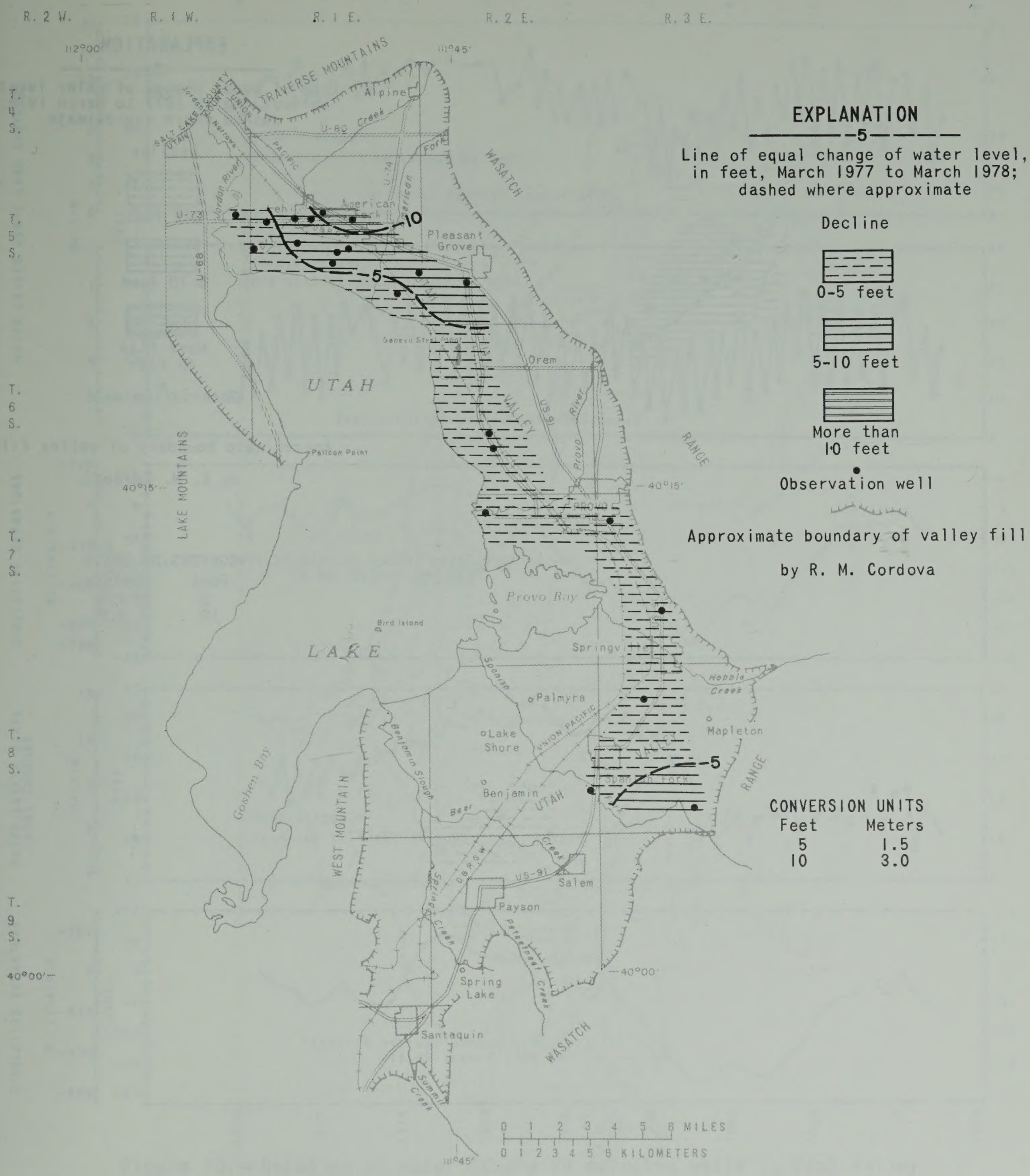


Figure 13.—Map of Utah Valley showing change of water levels in the deep artesian aquifer in rocks of Pleistocene age from March 1977 to March 1978.

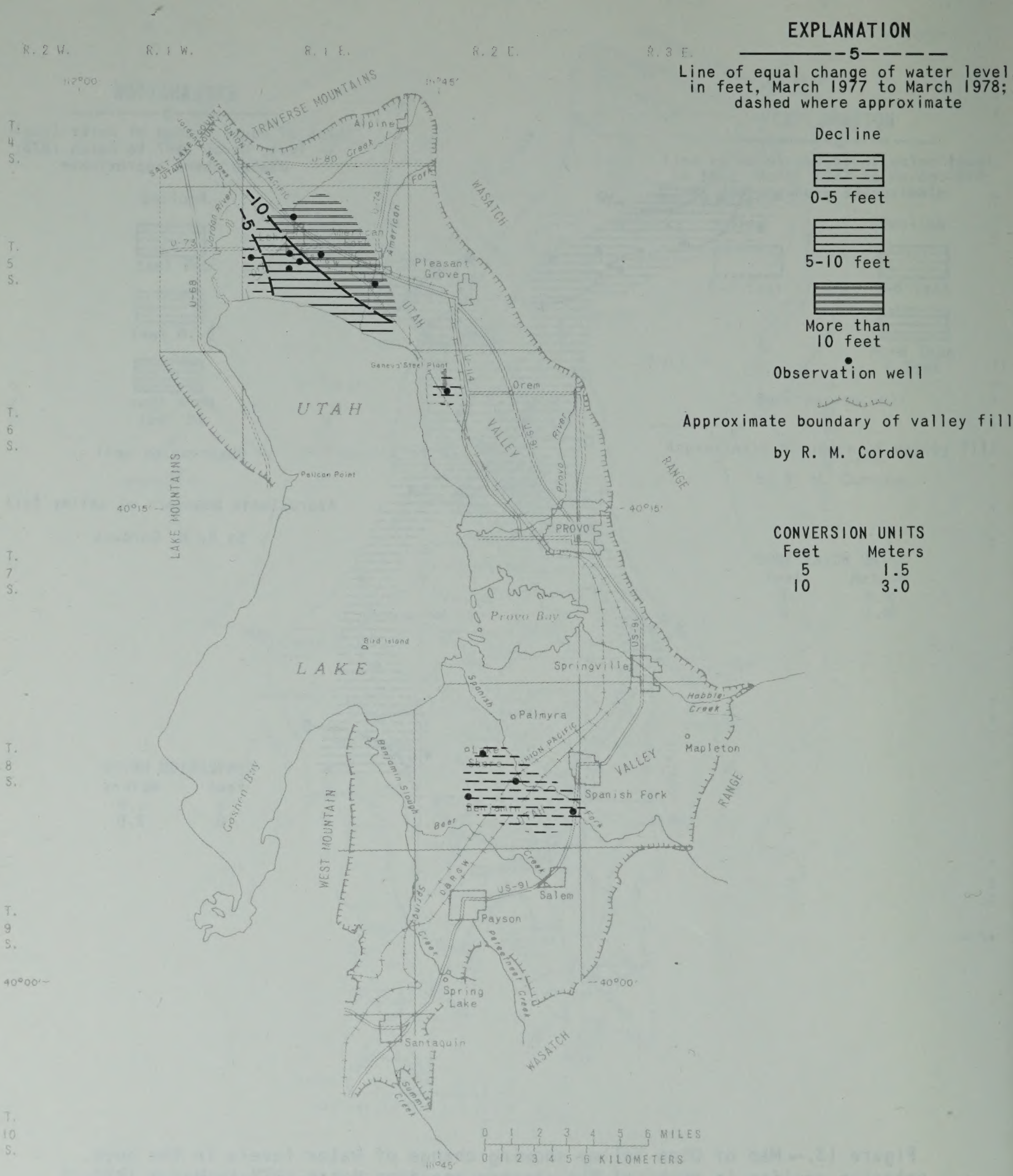


Figure 14.—Map of Utah Valley showing change of water levels in the artesian aquifer in rocks of Tertiary age from March 1977 to March 1978.

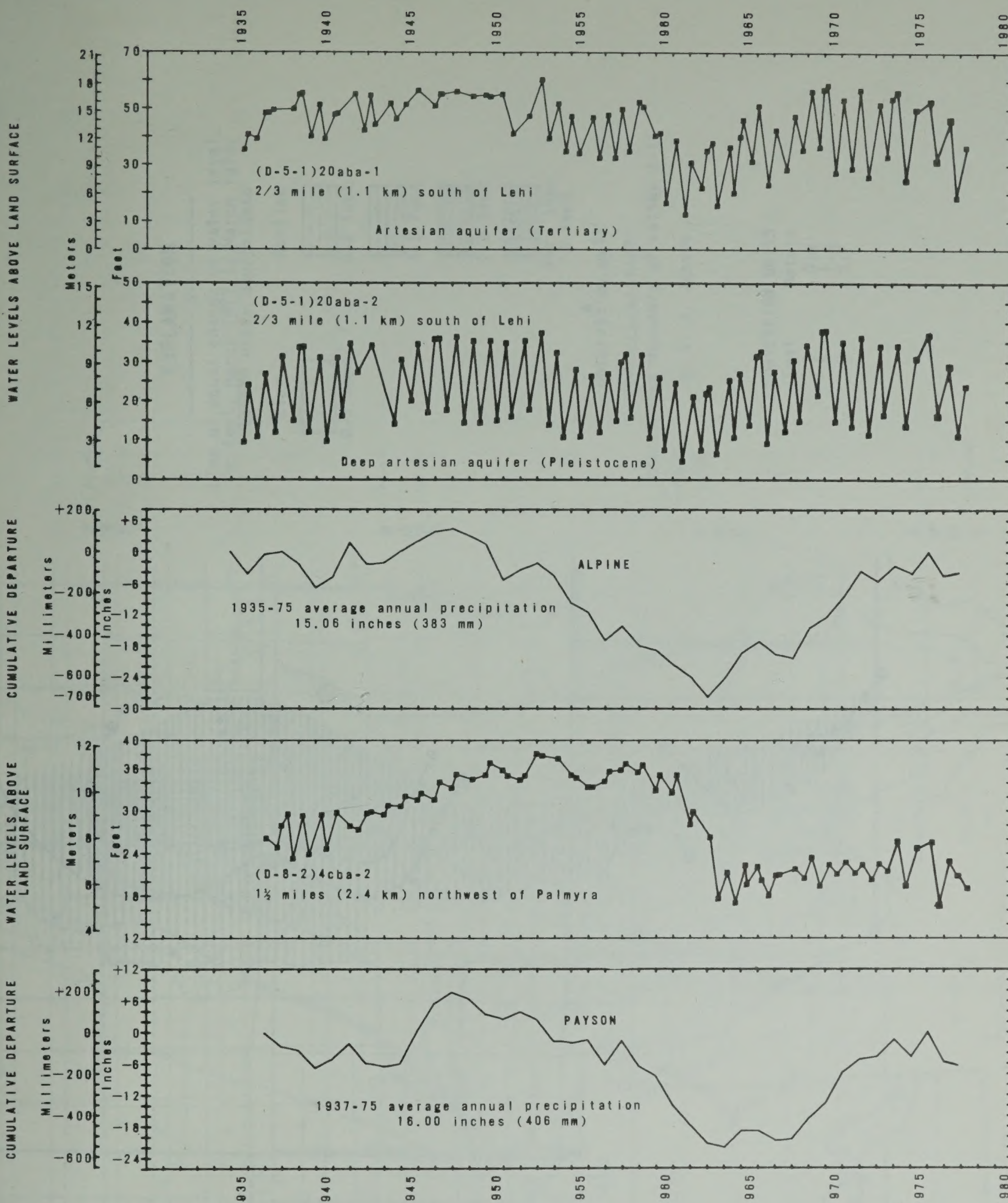
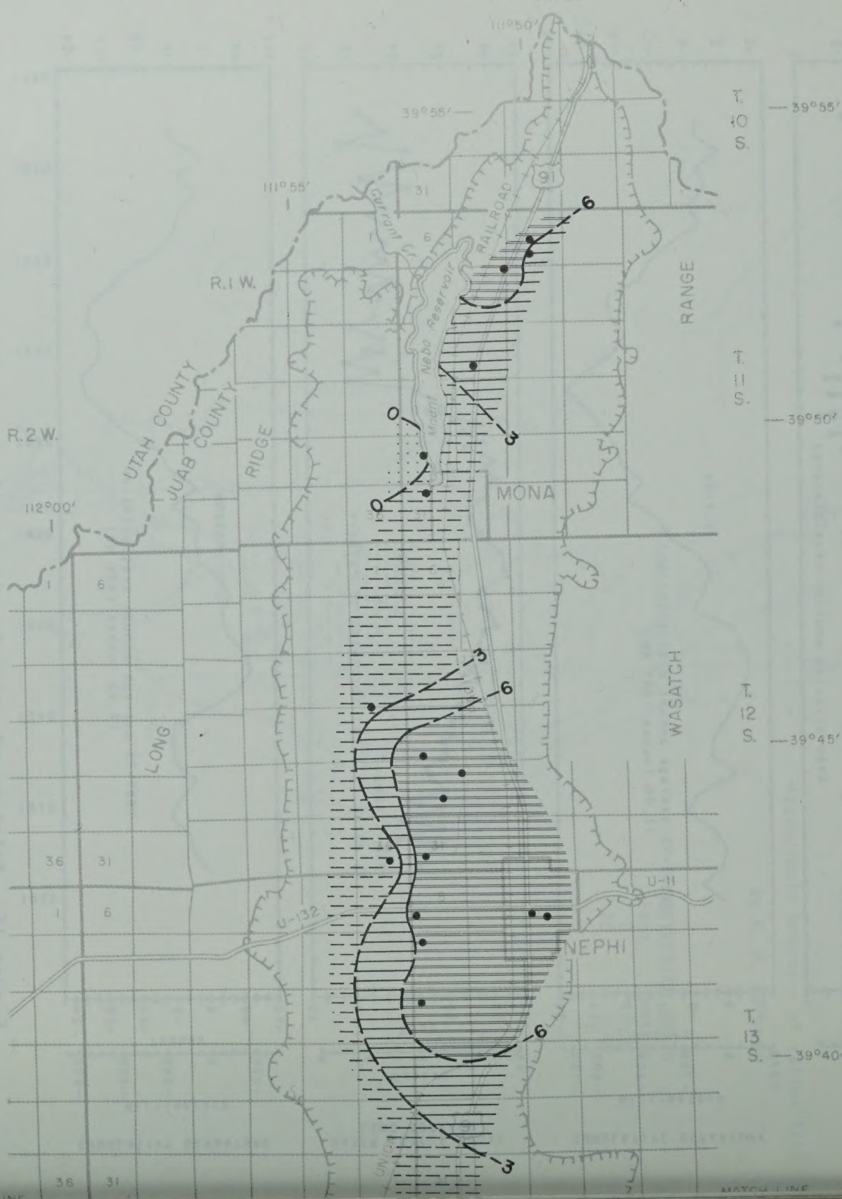


Figure 15.—Relation of water levels in selected wells in Utah Valley to cumulative departure from the average annual precipitation at Alpine and Payson.


111°50'
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MONA
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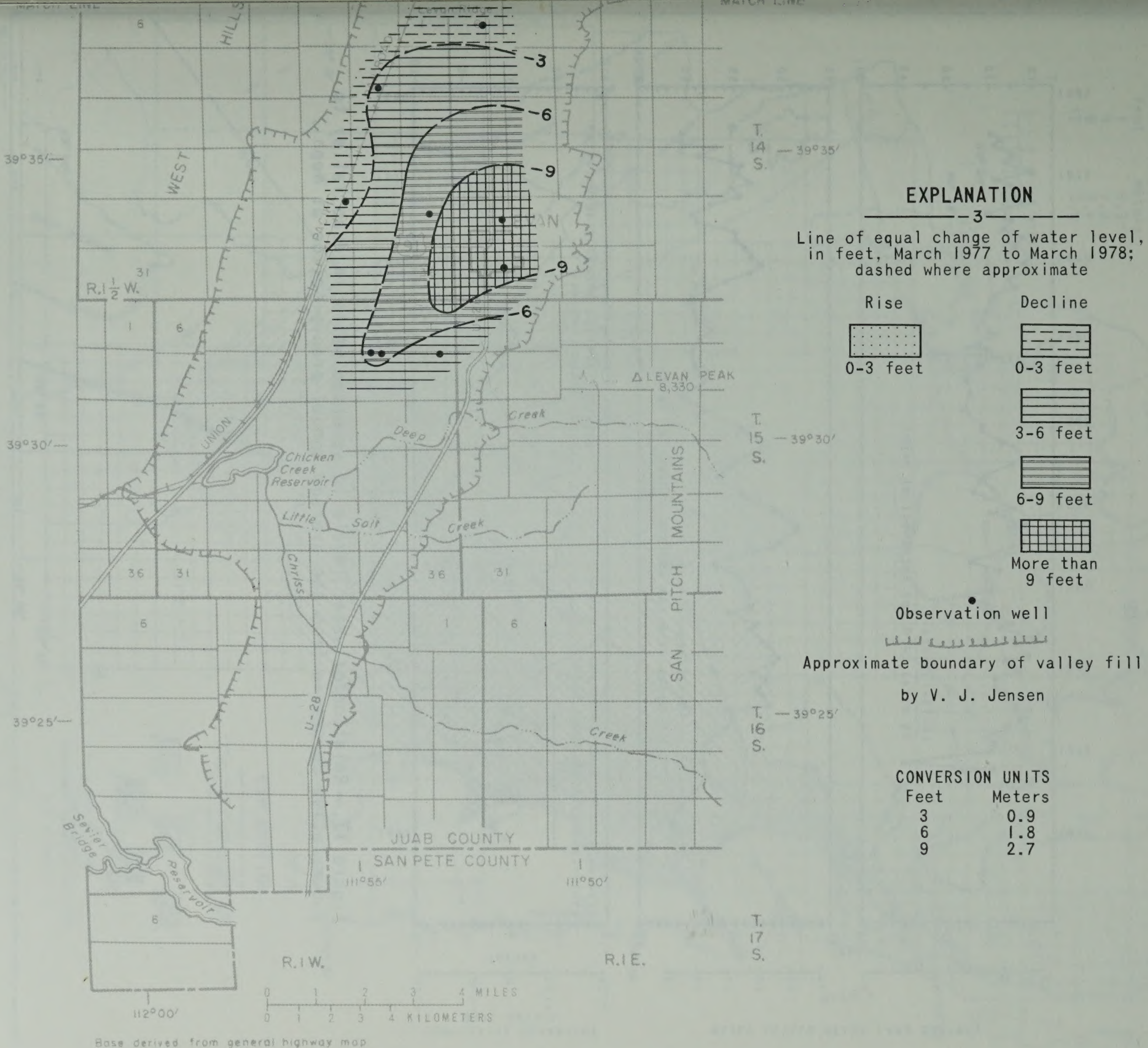


Figure 16.—Map of Juab Valley showing change of water levels from March 1977 to March 1978.

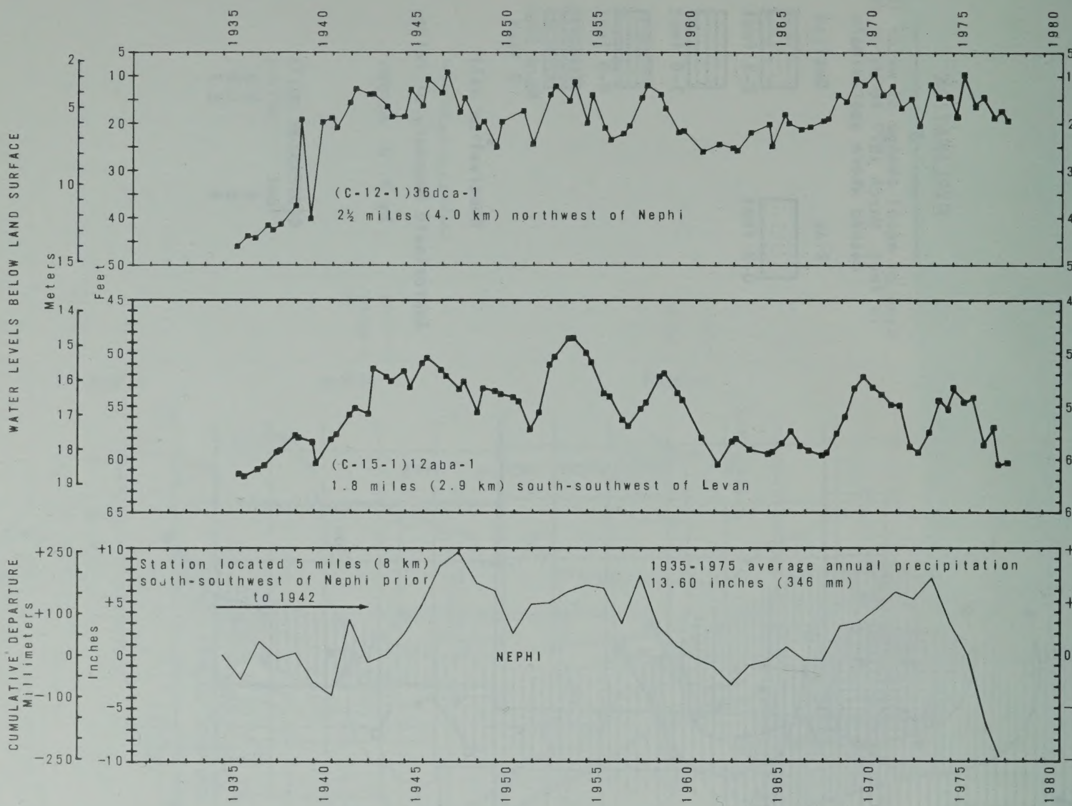


Figure 17.—Relation of water levels in selected wells in Juab Valley to cumulative departure from the average annual precipitation at Nephi.

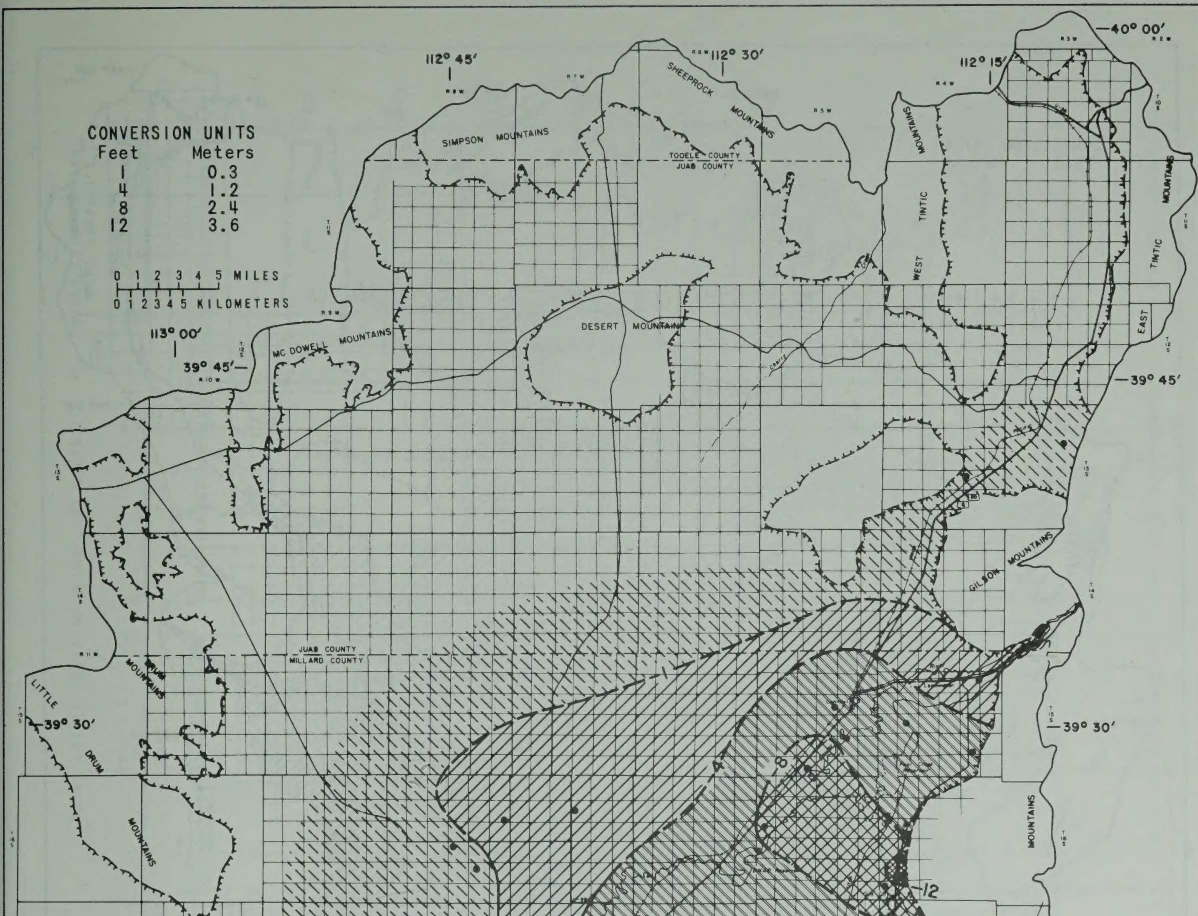


Figure 18.—Map of part of the Sevier Desert showing change of water levels in the lower artesian aquifer from March 1977 to March 1978.

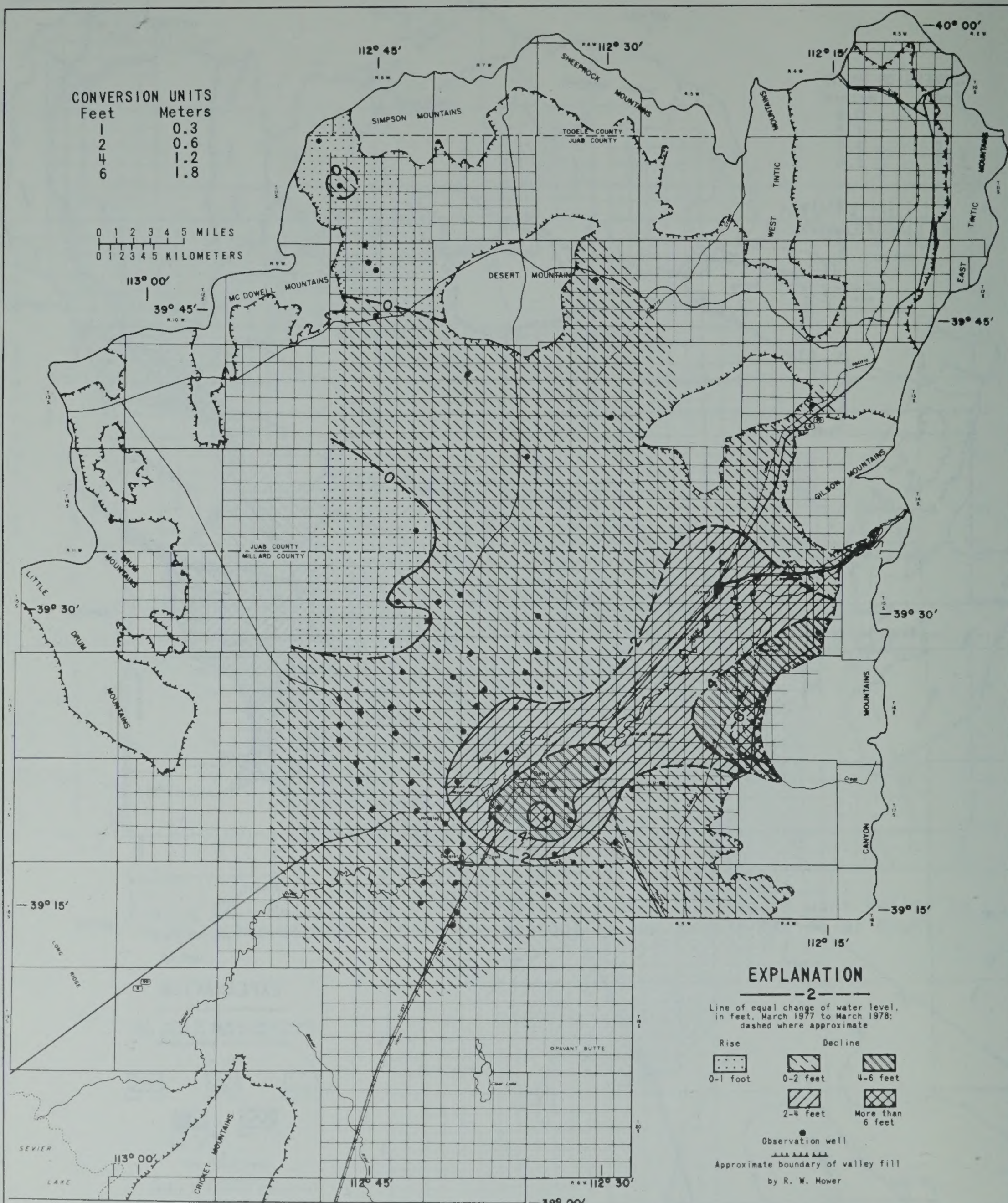


Figure 19.—Map of part of the Sevier Desert showing change of water levels in the upper artesian aquifer from March 1977 to March 1978.

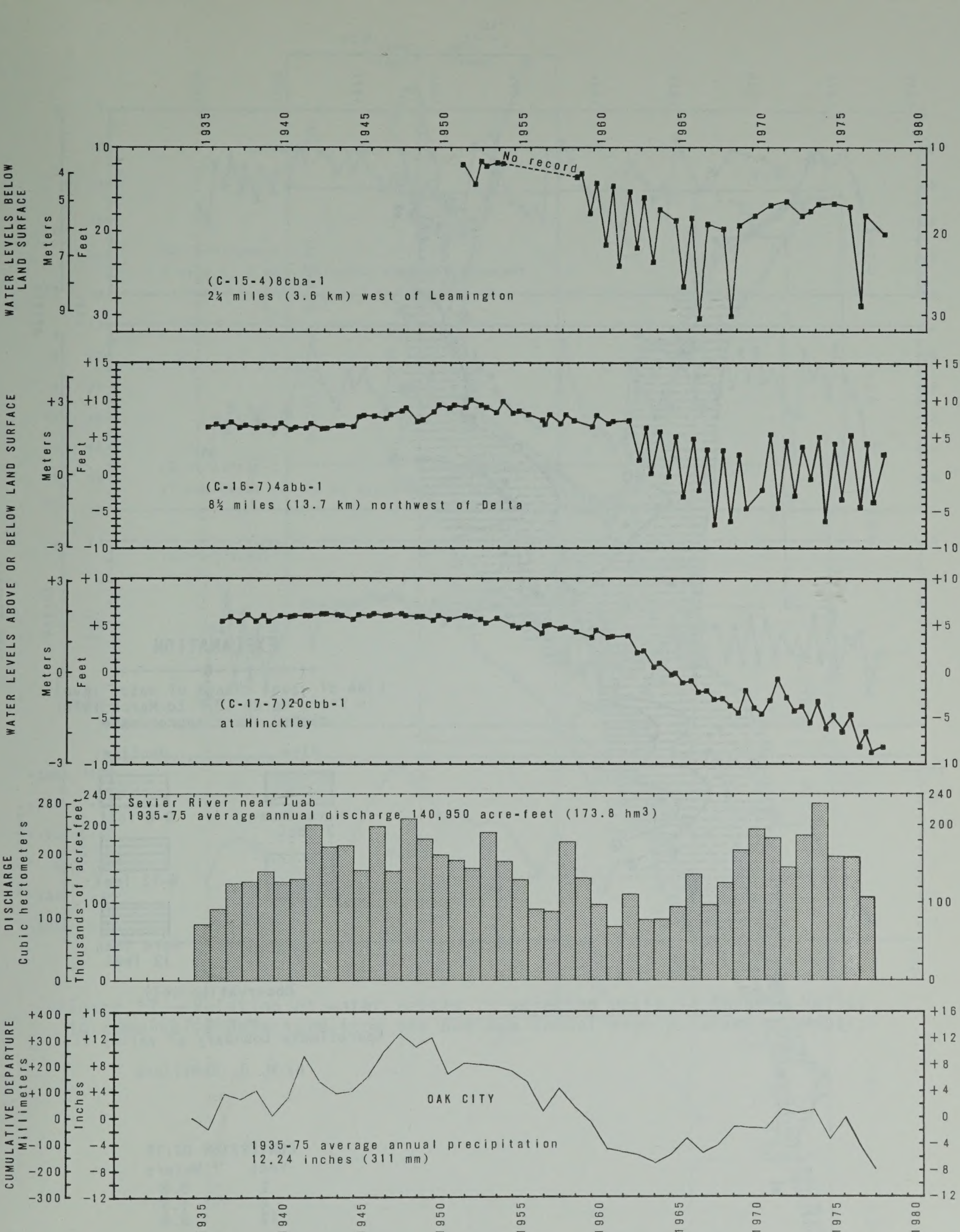


Figure 20.—Relation of water levels in selected wells in the Sevier Desert to discharge of the Sevier River near Juab and to cumulative departure from the average annual precipitation at Oak City.

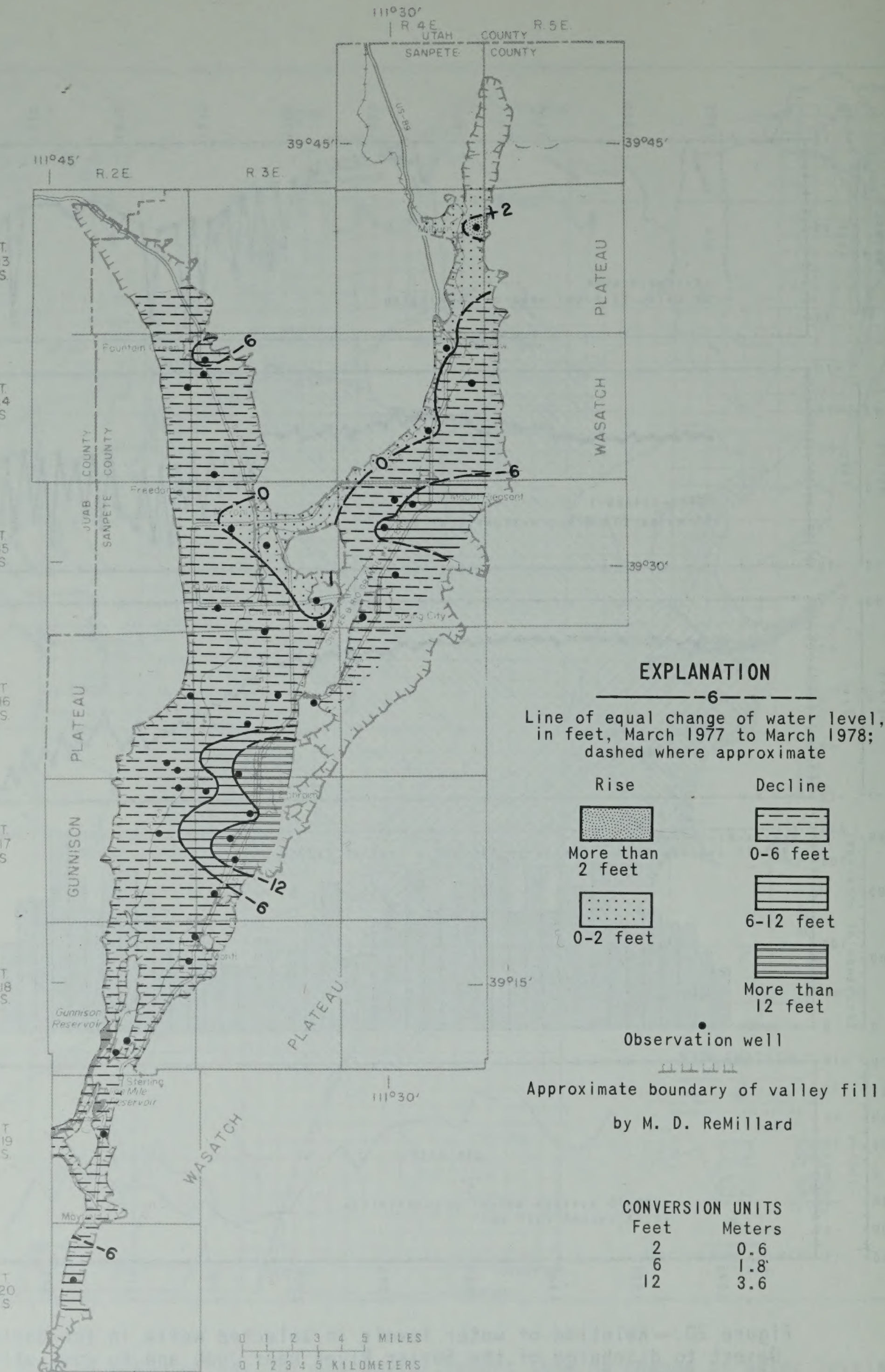


Figure 21.—Map of Sanpete Valley showing change of water levels from March 1977 to March 1978.

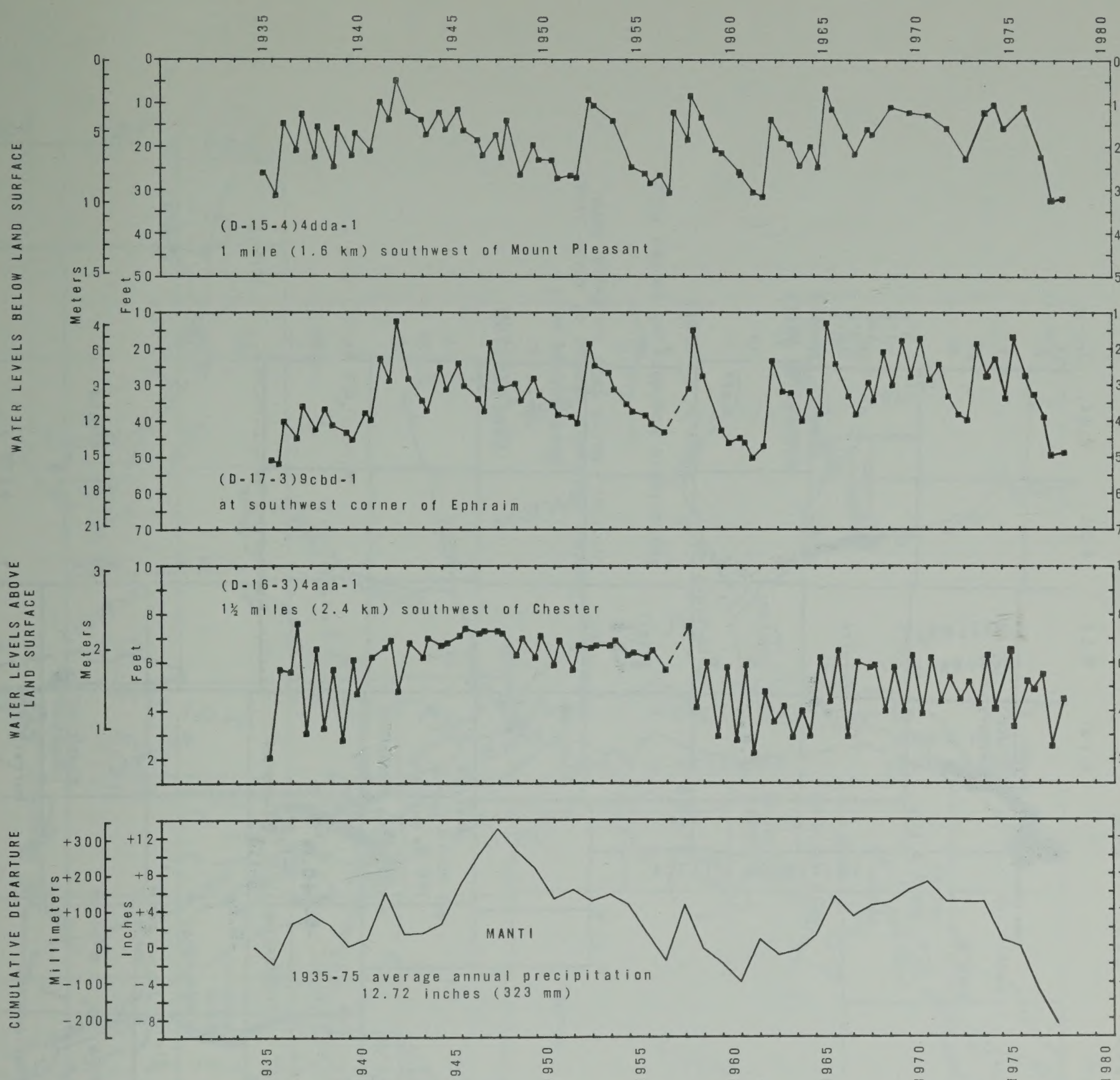
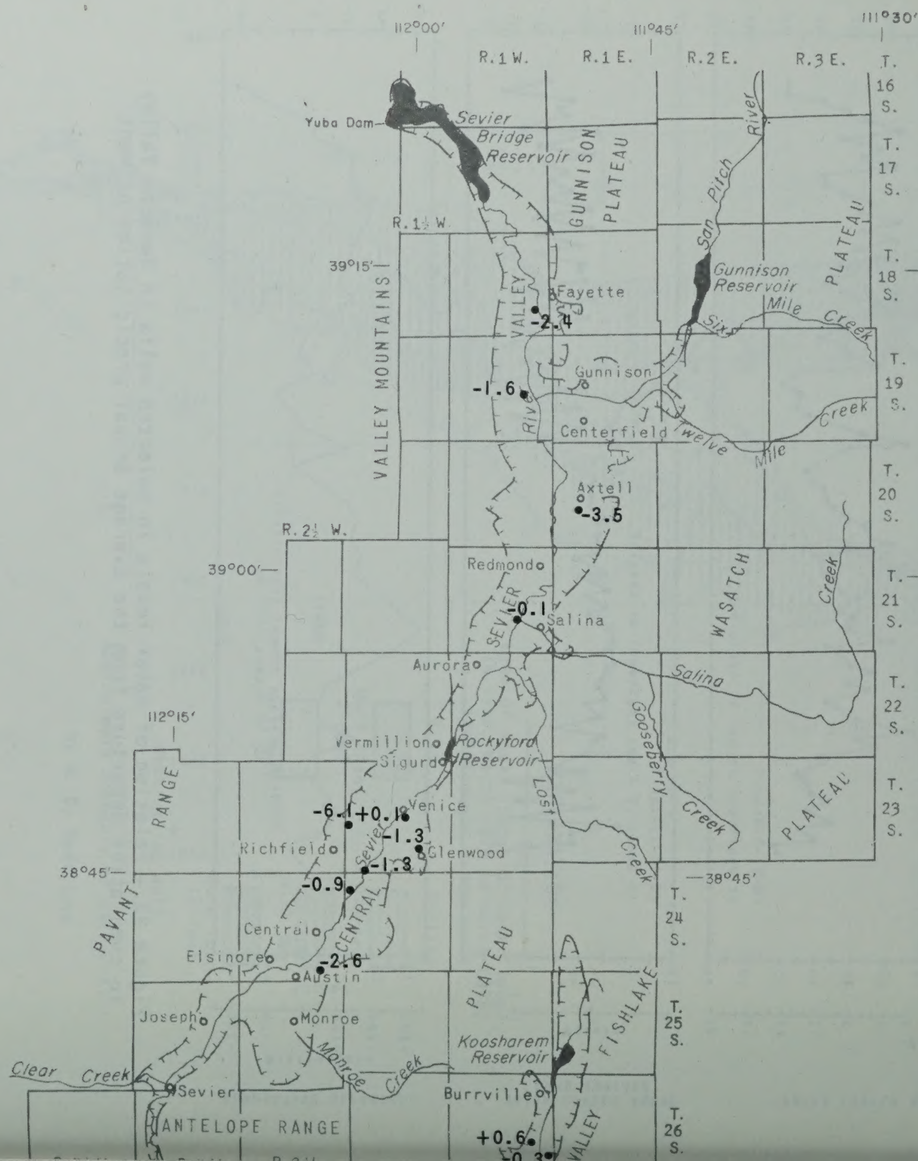


Figure 22.—Relation of water levels in selected wells in Sanpete Valley to cumulative departure from the average annual precipitation at Manti.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T. 20 S.
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T. 22 S.
T. 23 S.
T. 24 S.
T. 25 S.
T. 26 S.
R.1½ W.
R.2½ W.
39°15′
39°00′
38°45′
112°15′
Yuba Dam
Sevier Bridge Reservoir
GUNNISON PLATEAU
San Pitch River
Gunnison Reservoir
Six Mile Creek
Twelve Mile Creek
PLATEAU
VALLEY MOUNTAINS
VALLEY
Fayette
-2.4
Gunnison
-1.6
River
Centerfield
Axtell
-3.5
Redmond
SEVIER
-0.1
Salina
WASATCH
Creek
Aurora
Salina
Gooseberry Creek
Lost Creek
Vermillion
Rockyford Reservoir
Sigurd
Venice
-6.1
+0.1
-1.3
-1.3
Glenwood
Richfield
Sevier
-0.9
CENTRAL
PLATEAU
RANGE
PAVANT
Central
Elsinore
-2.6
Austin
Joseph
Monroe
Monroe Creek
Koosharem Reservoir
FISHLAKE
Clear Creek
Sevier
Burrville
ANTELOPE RANGE
VALLEY
+0.6

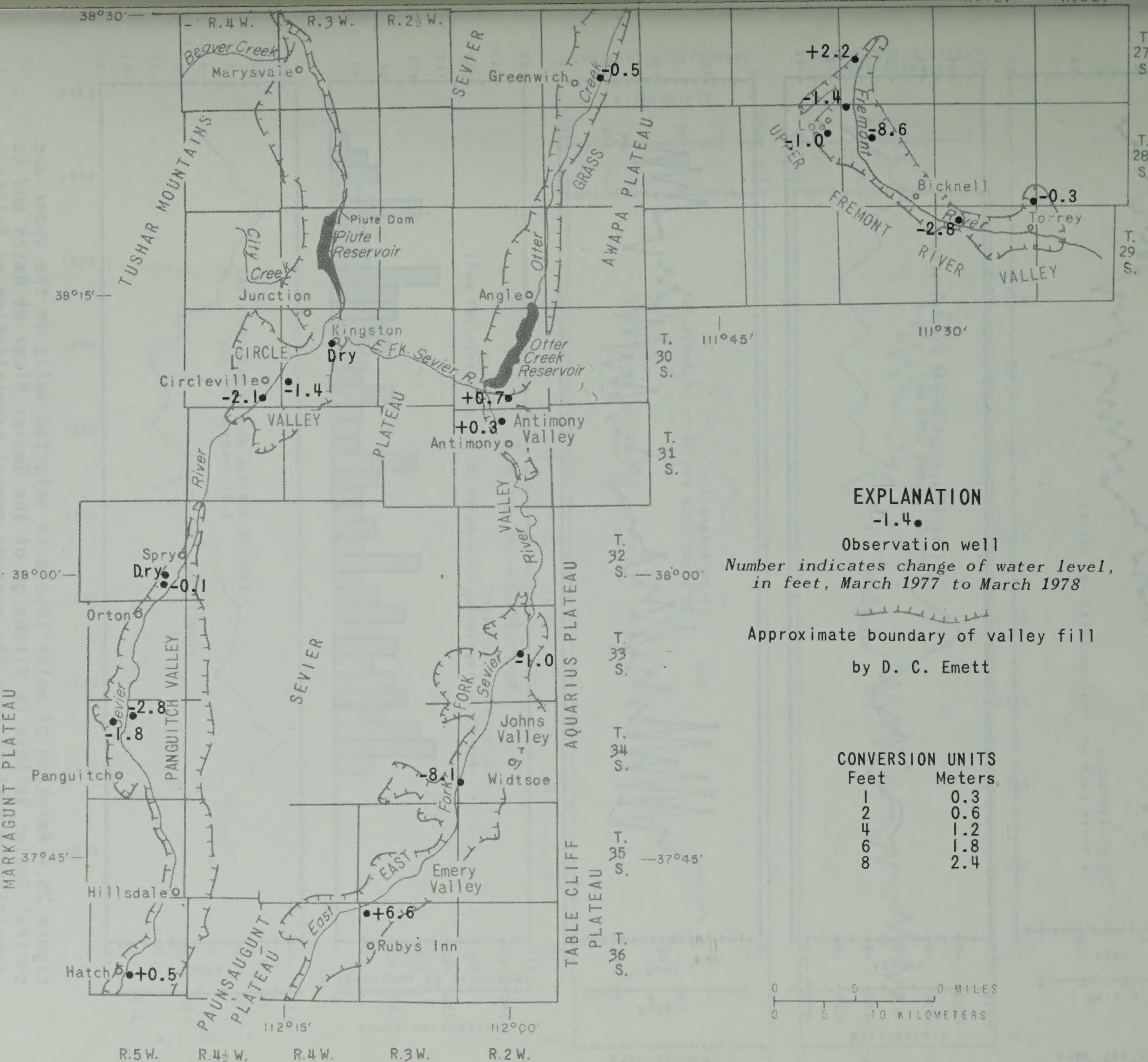

Figure 23.—Map of the upper and central Sevier and upper Fremont River Valleys showing change of water levels from March 1977 to March 1978.

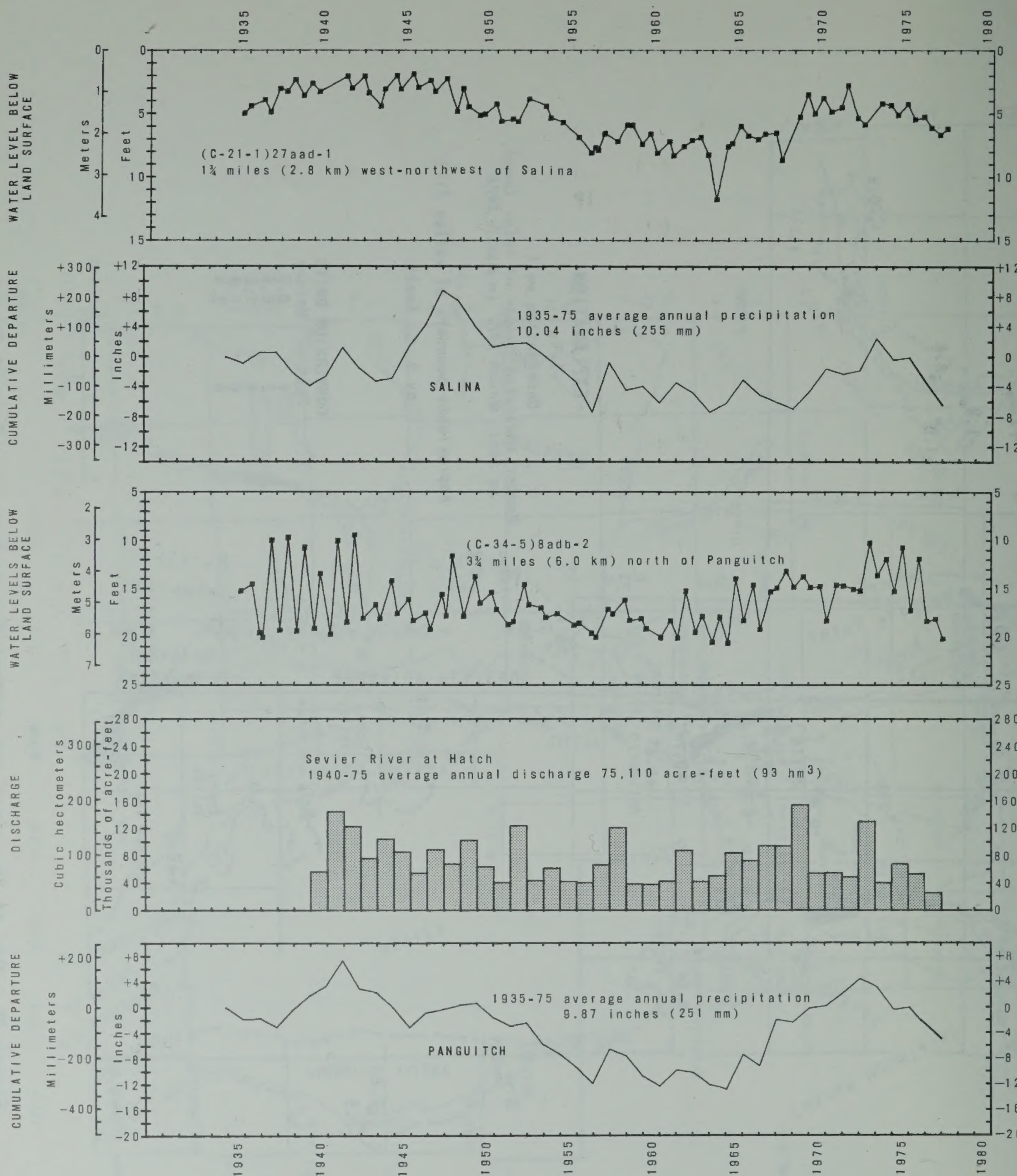

Figure 24.—Relation of water levels in selected wells in the upper and central Sevier Valleys to discharge of the Sevier River at Hatch and to cumulative departure from the average annual precipitation at Salina and Panguitch and relation of the water level in well (D-28-4)36cdb-1 to cumulative departure from the average annual precipitation at Loa.

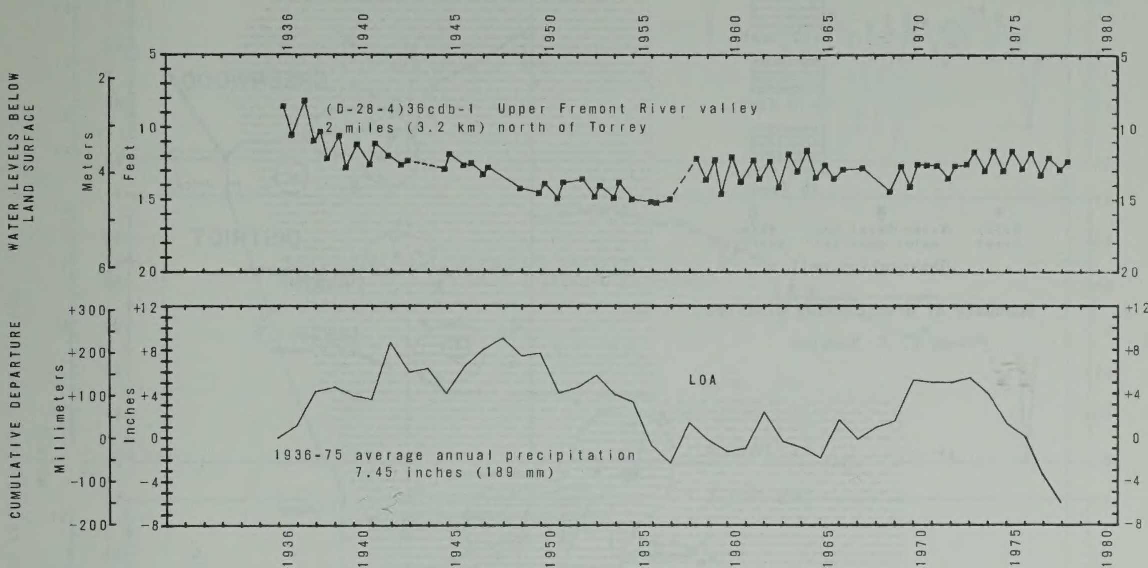

Figure 24.—Continued.

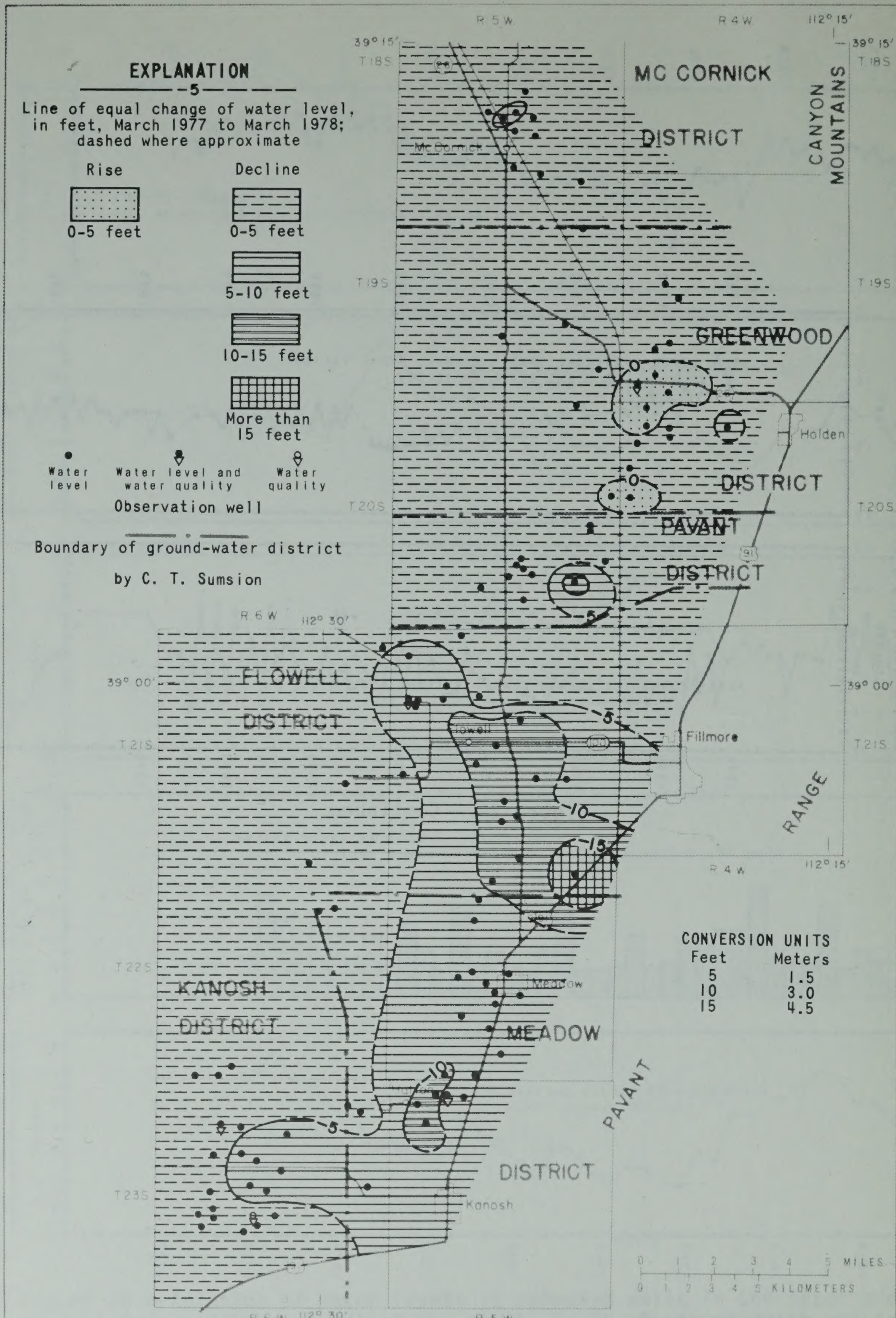

Figure 25.—Map of Pavant Valley showing change of water levels from March 1977 to March 1978.

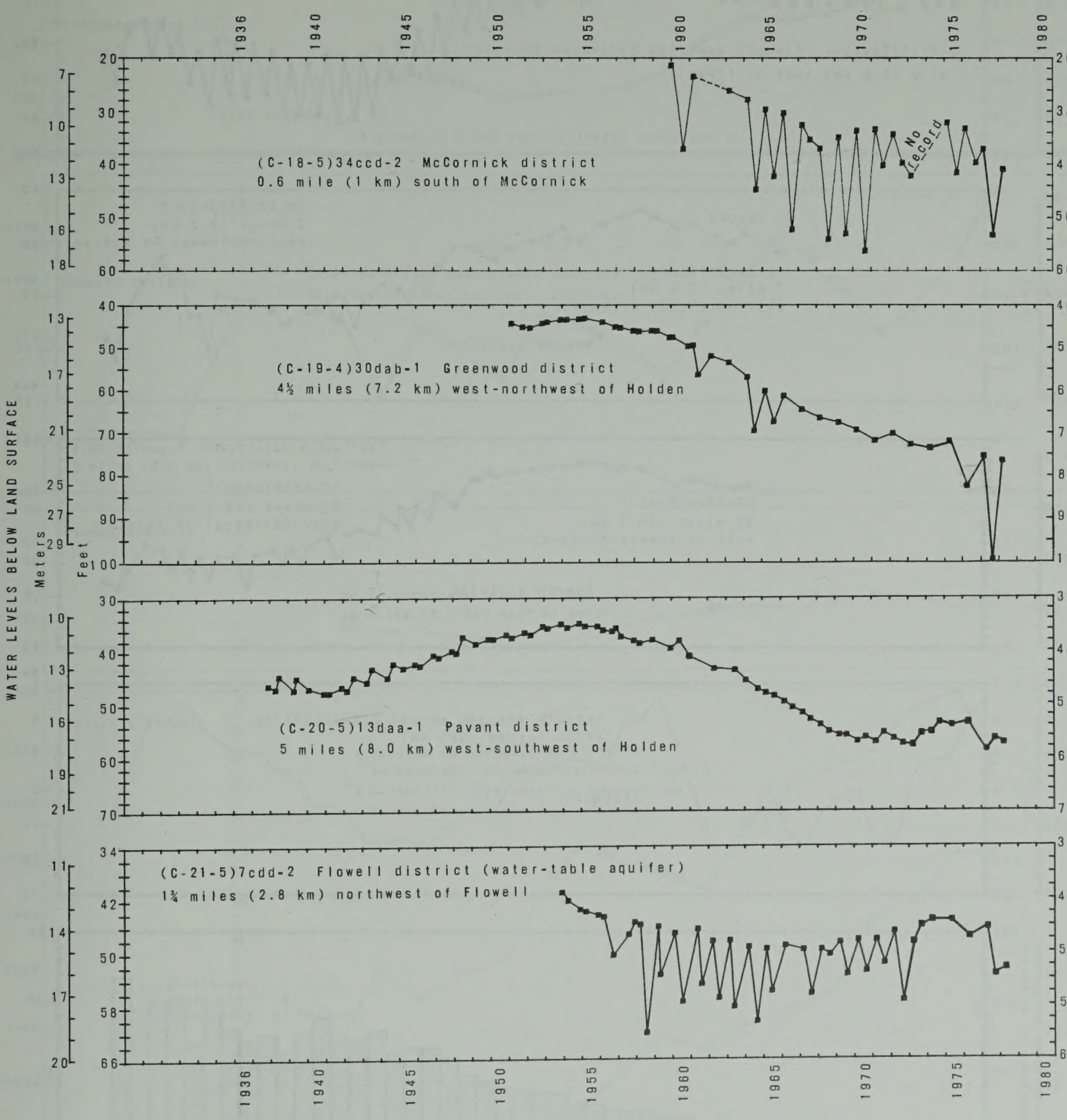

Figure 26.— Relation of water levels in selected wells in Pavant Valley to cumulative departure from the average annual precipitation at Fillmore and to total withdrawals from wells.

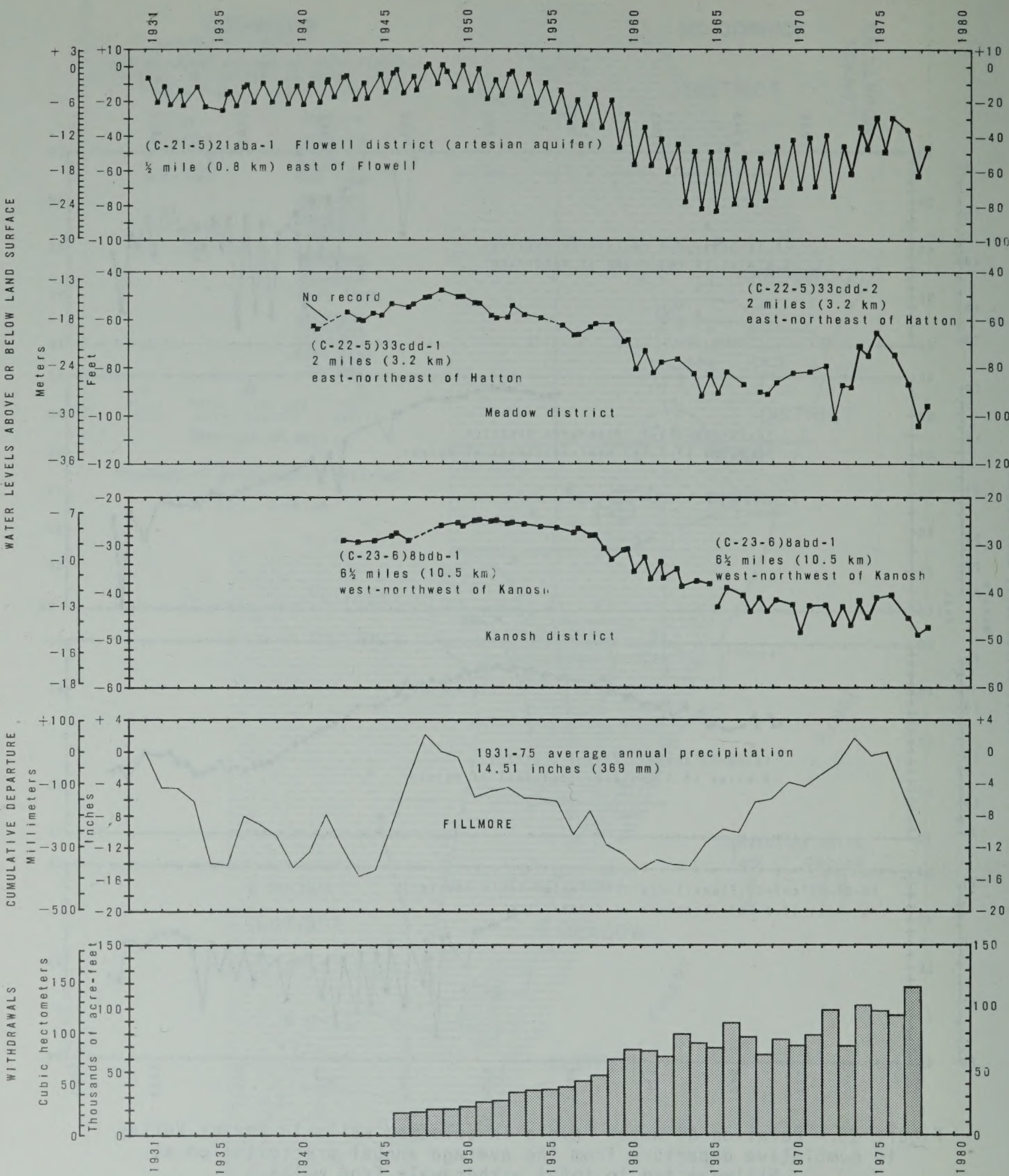

Figure 26.—Continued.

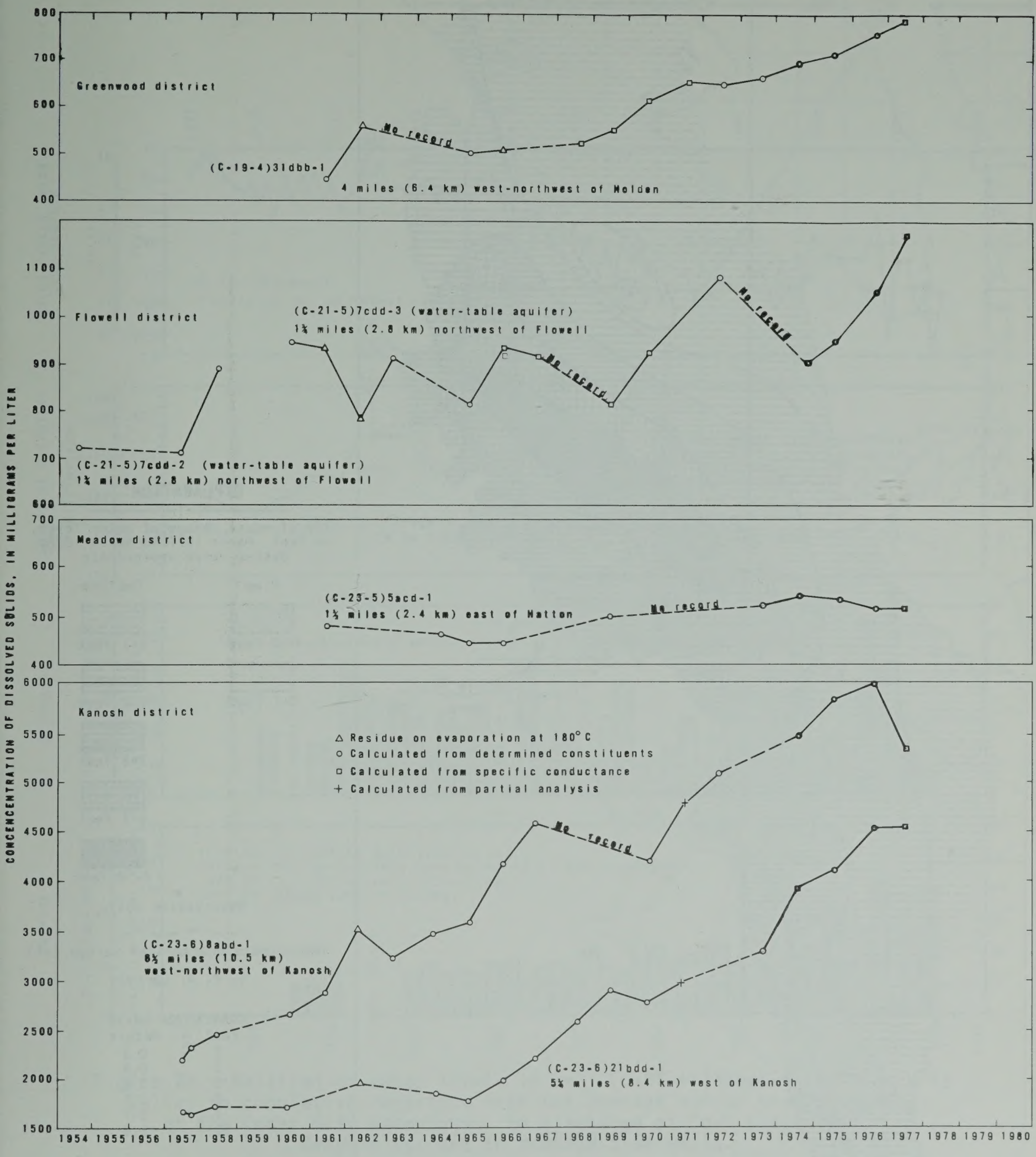

Figure 27.— Concentration of dissolved solids in water from selected wells in Pavant Valley.

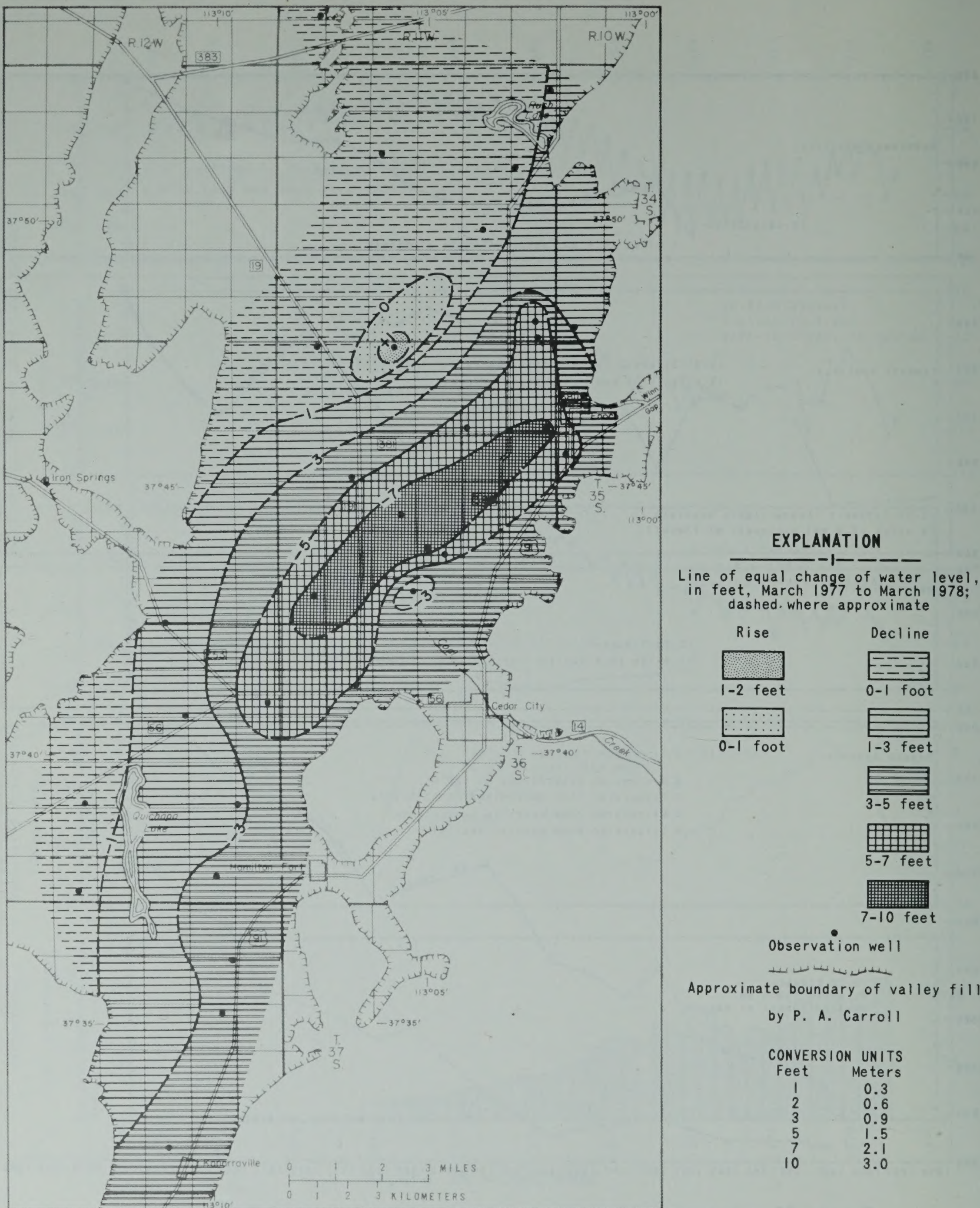

Figure 28.—Map of Cedar City Valley showing change of water levels from March 1977 to March 1978.

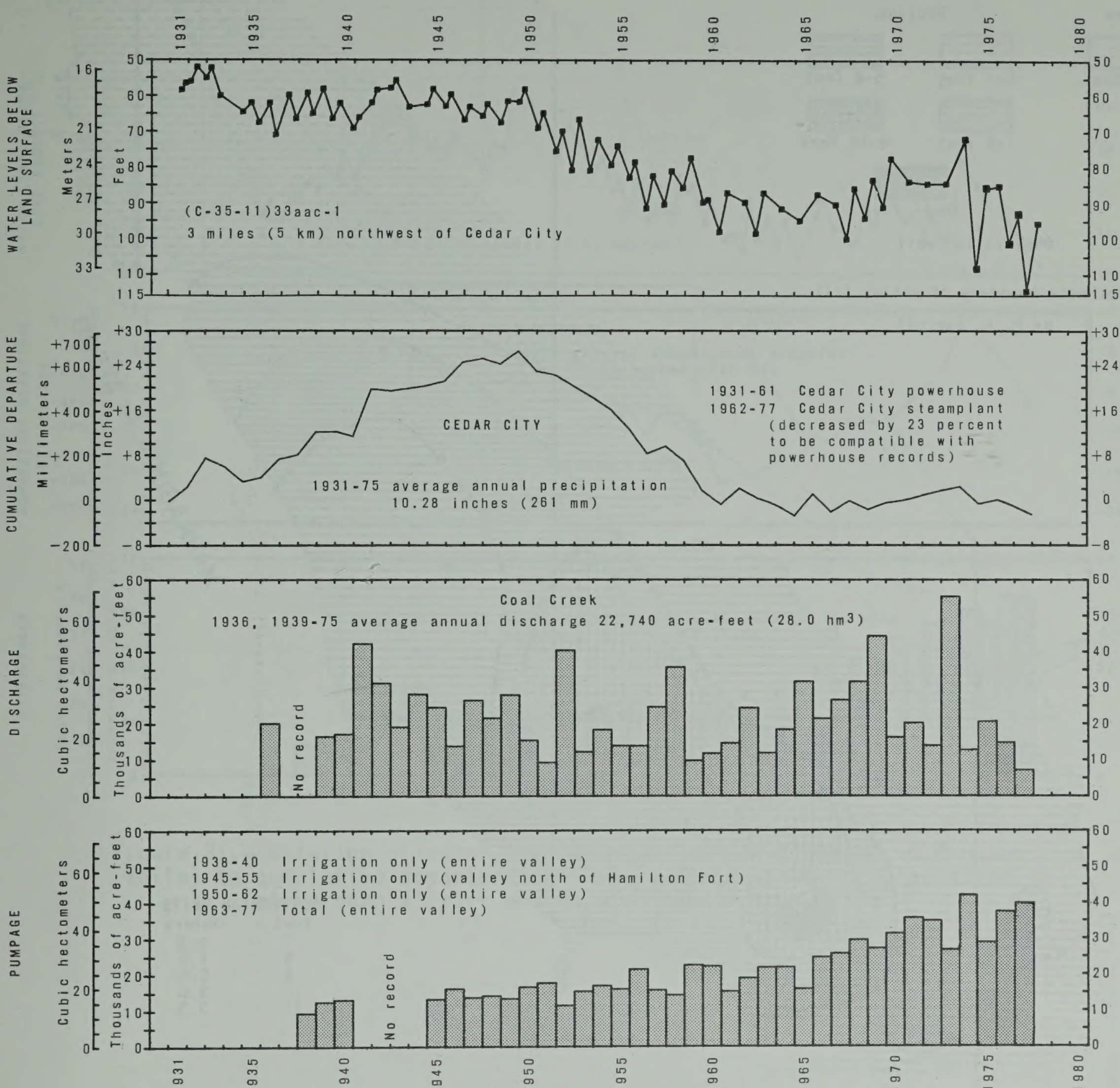

Figure 29.—Relation of water levels in well (C-35-11)33aac-1 in Cedar City Valley to cumulative departure from the average annual precipitation at the Cedar City powerhouse, to discharge of Coal Creek near Cedar City, and to pumpage from wells.

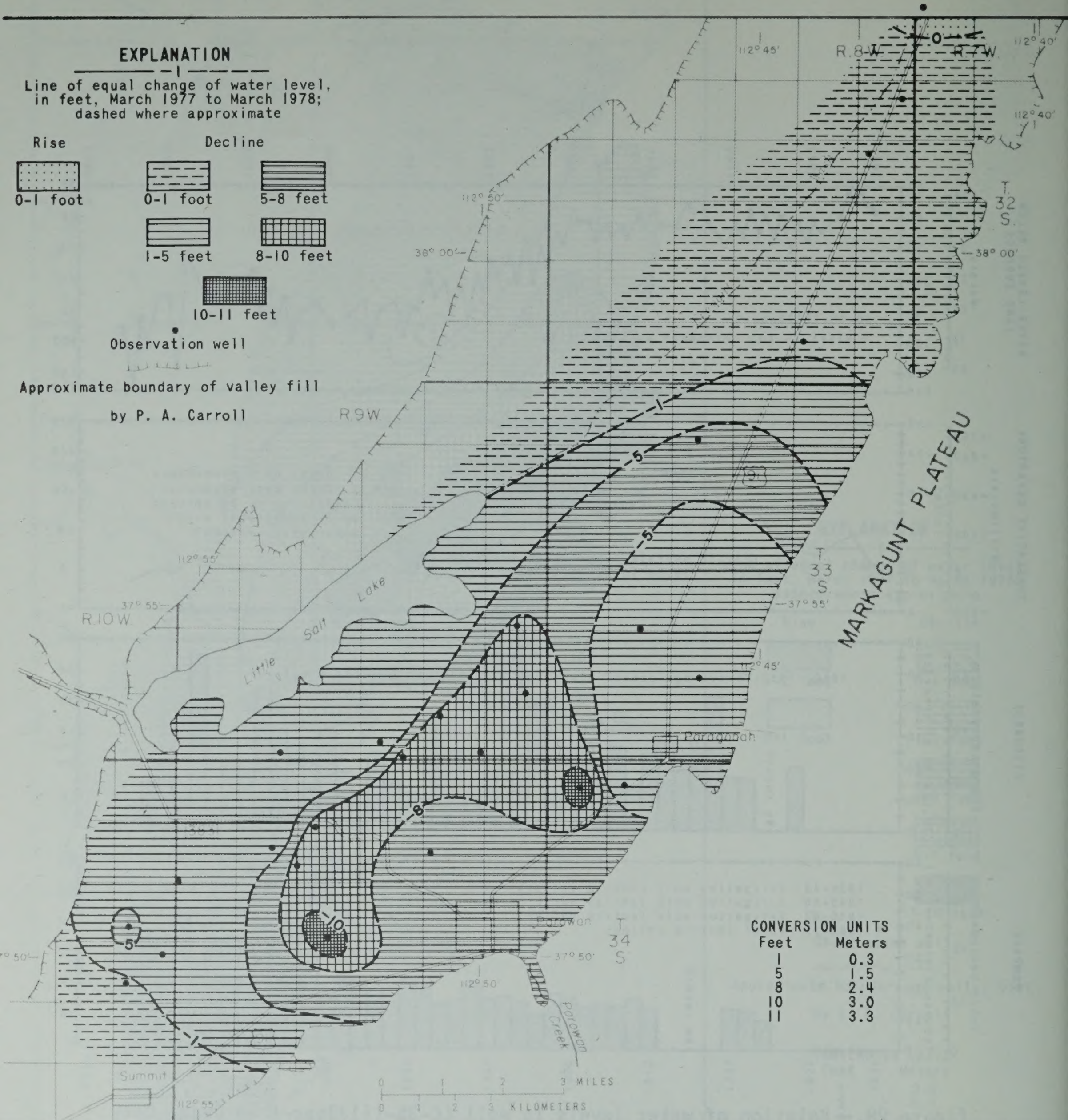

Figure 30.—Map of Parowan Valley showing change of water levels from March 1977 to March 1978.

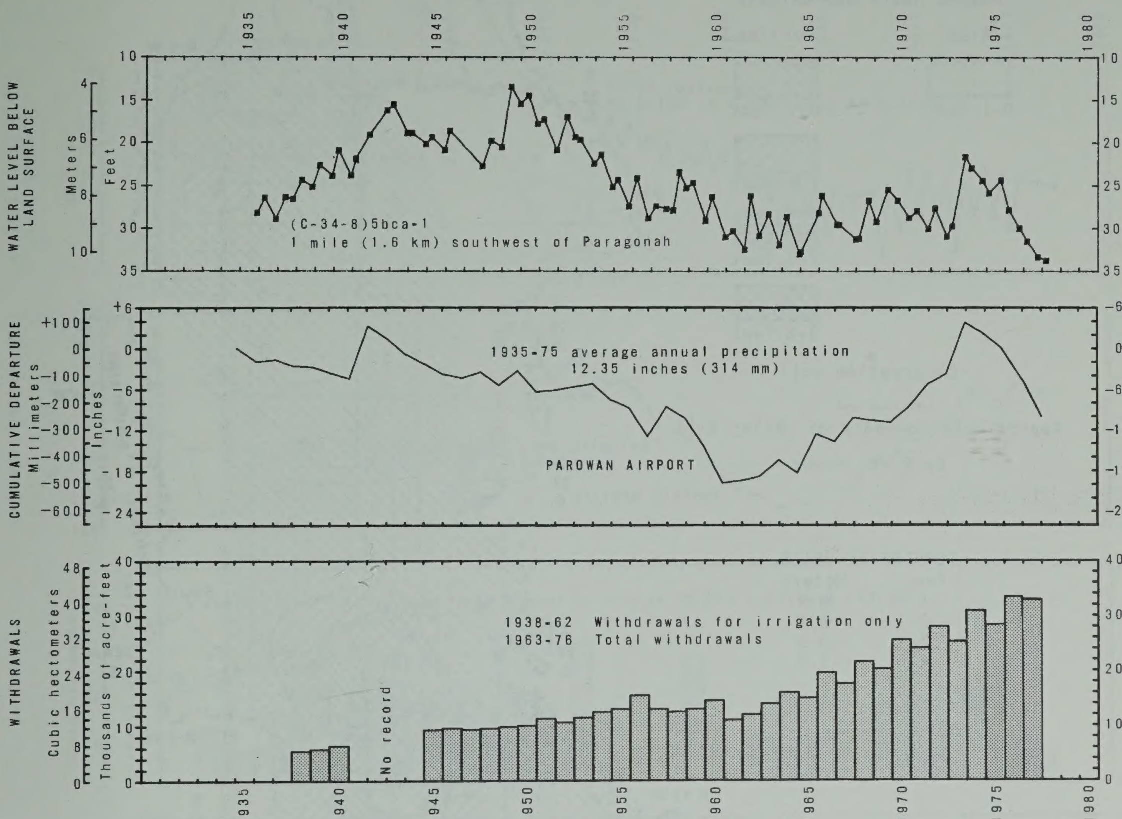

Figure 31.— Relation of water levels in well (C-34-8)5bca-1 in Parowan Valley to cumulative departure from the average annual precipitation at Parowan Airport and to withdrawals from wells.

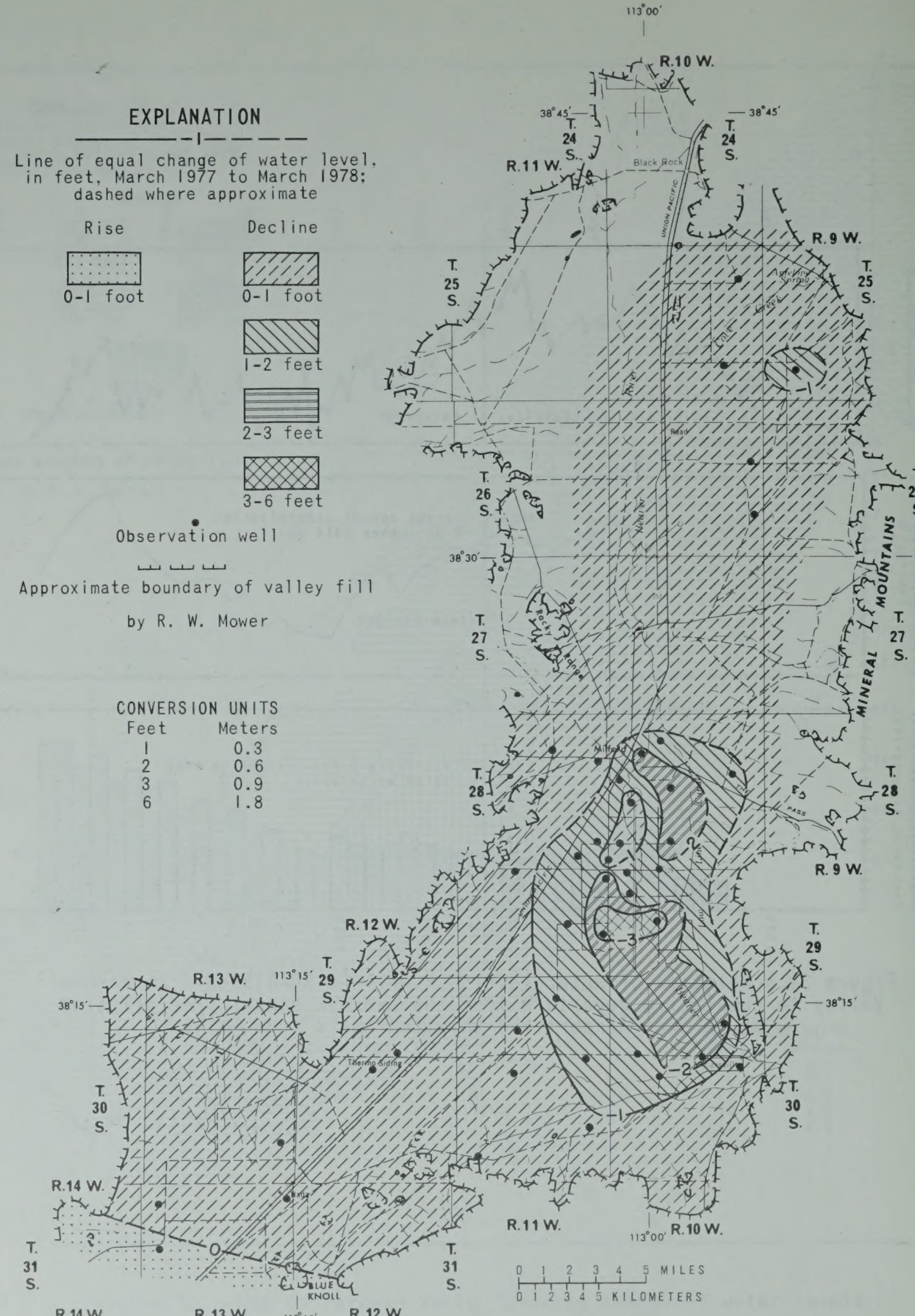

Figure 32.—Map of the Milford area, Escalante Valley, showing change of water levels from March 1977 to March 1978.

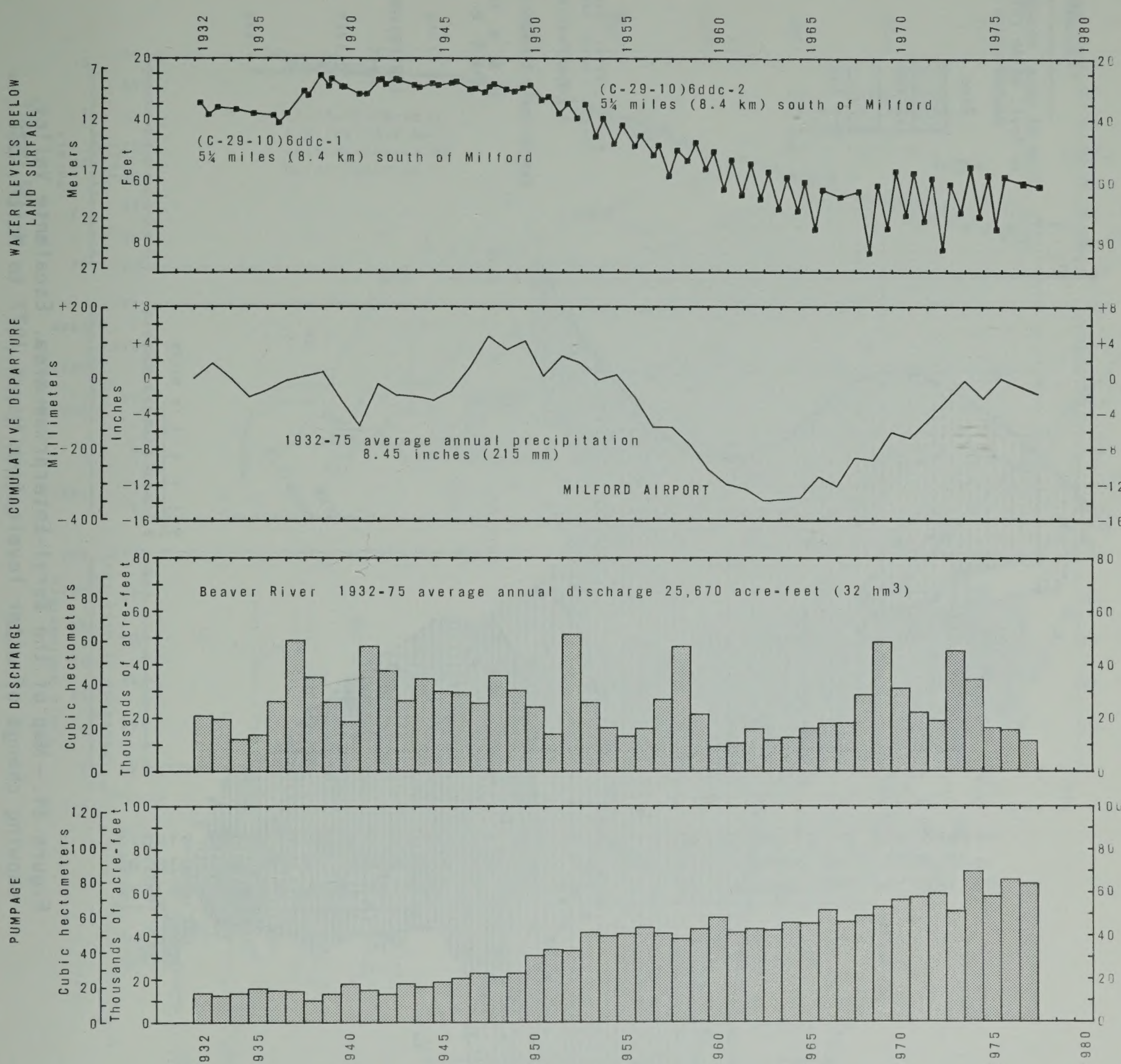

Figure 33.— Relation of water levels in selected wells in the Milford area, Escalante Valley, to cumulative departure from the average annual precipitation at Milford Airport, to discharge of the Beaver River at Rocky Ford Dam near Minersville, and to pumpage for irrigation.

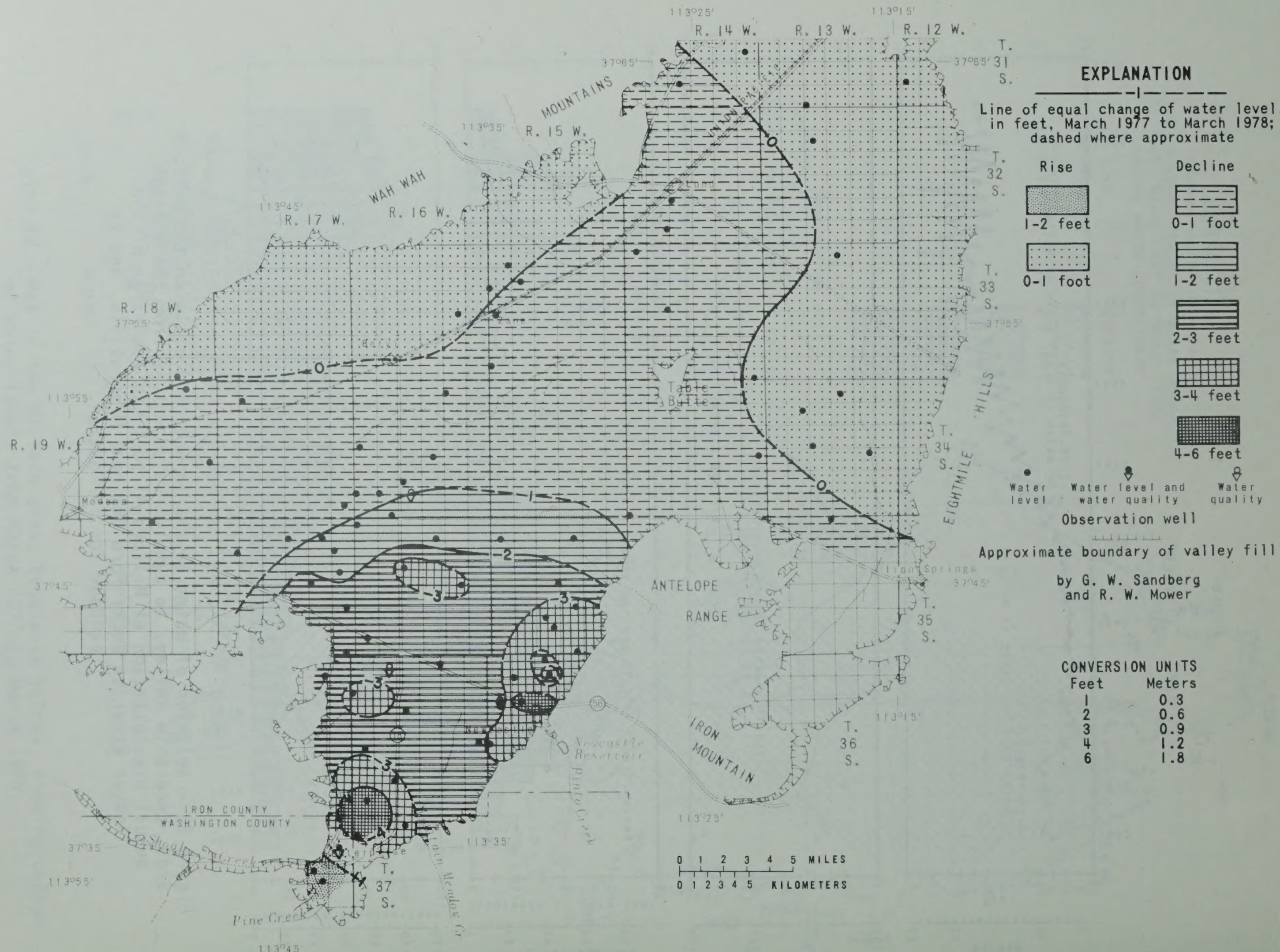

Figure 34.—Map of the Beryl-Enterprise area, Escalante Valley, showing change of water levels from March 1977 to March 1978.

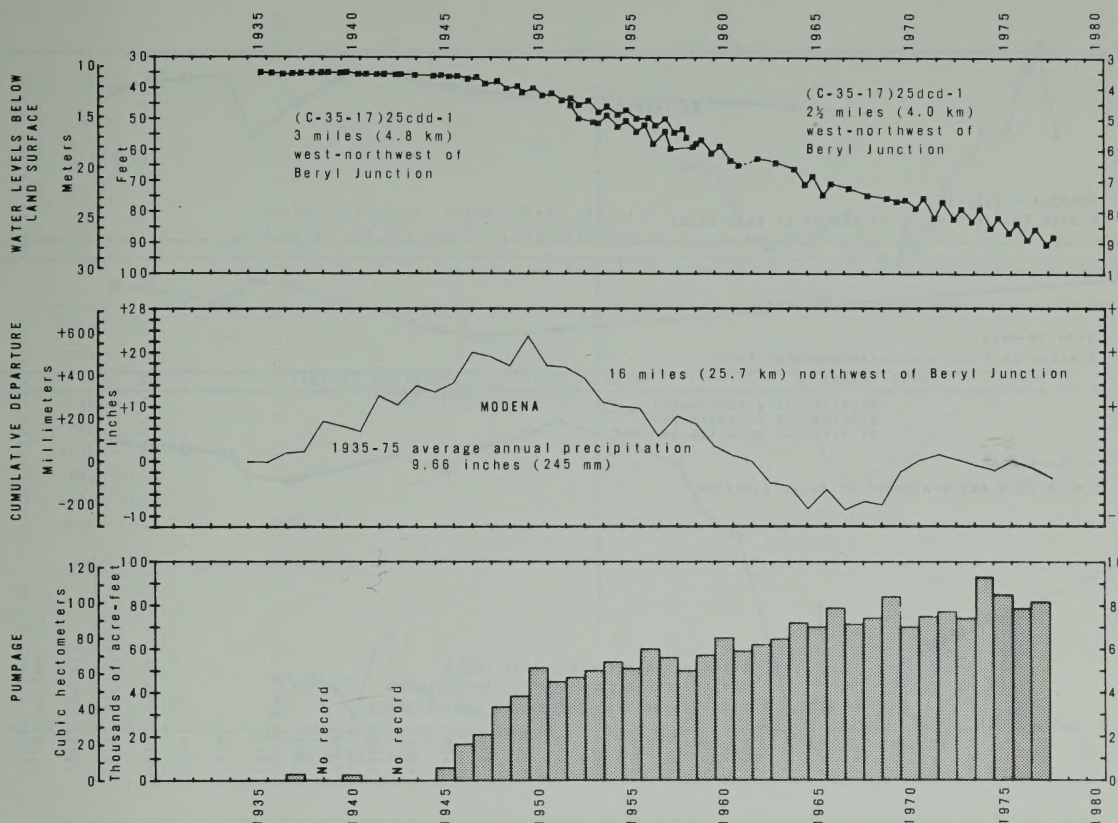

Figure 35.— Relation of water levels in selected wells in the Beryl-Enterprise area, Escalante Valley, to cumulative departure from the average annual precipitation at Modena and to pumpage for irrigation.

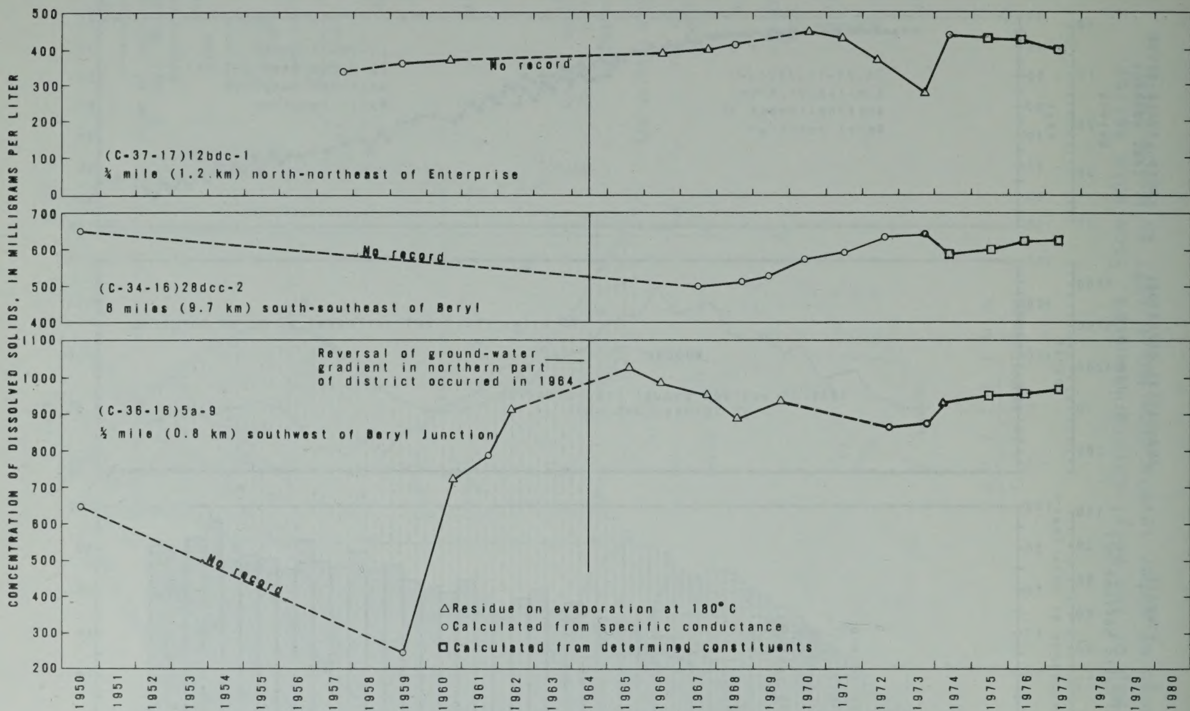

Figure 36.— Concentration of dissolved solids in water from selected wells in the Beryl-Enterprise area, Escalante Valley.

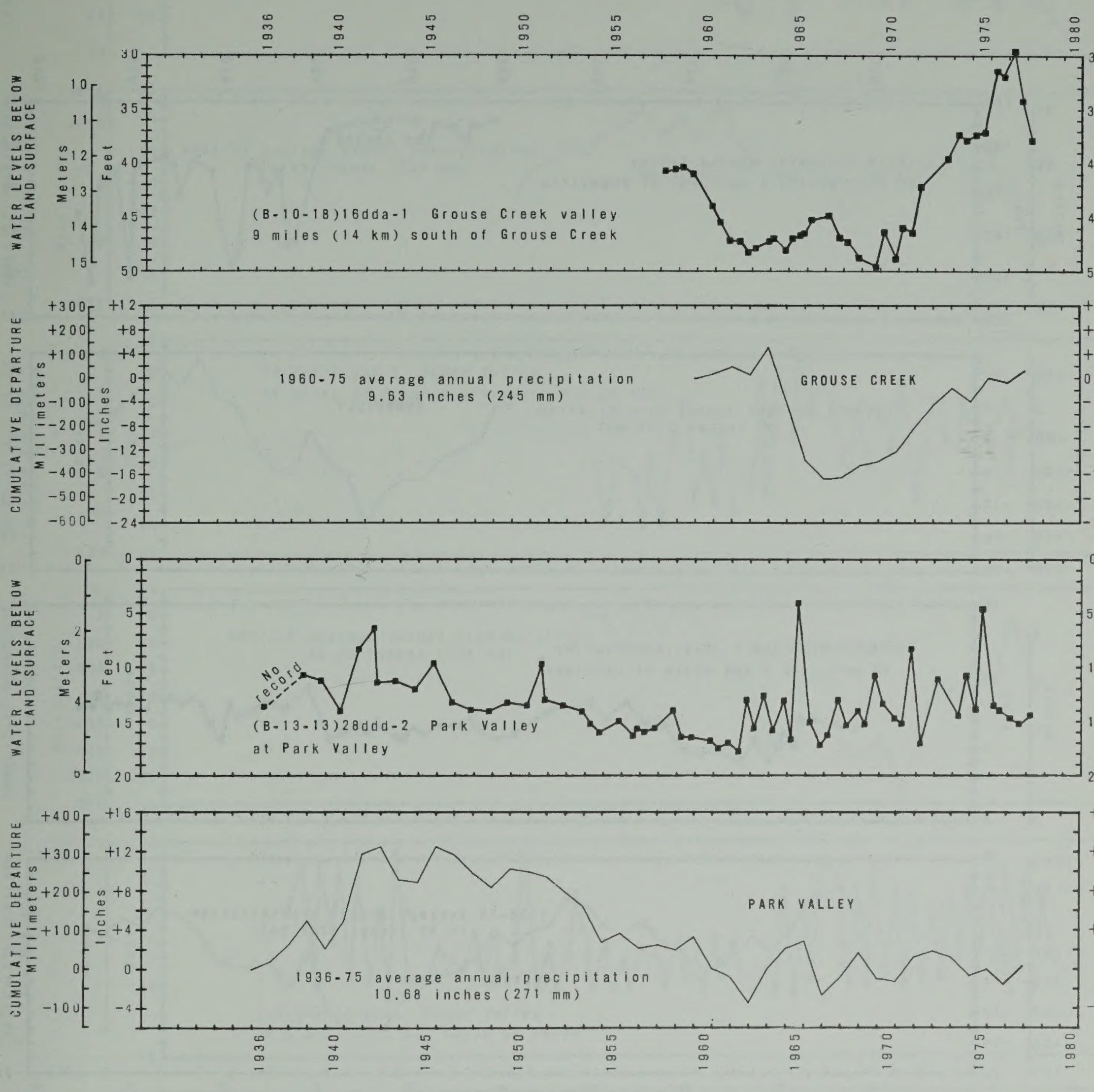

Figure 37.— Relation of water levels in wells in selected areas of Utah to cumulative departure from the average annual precipitation at sites in or near those areas.

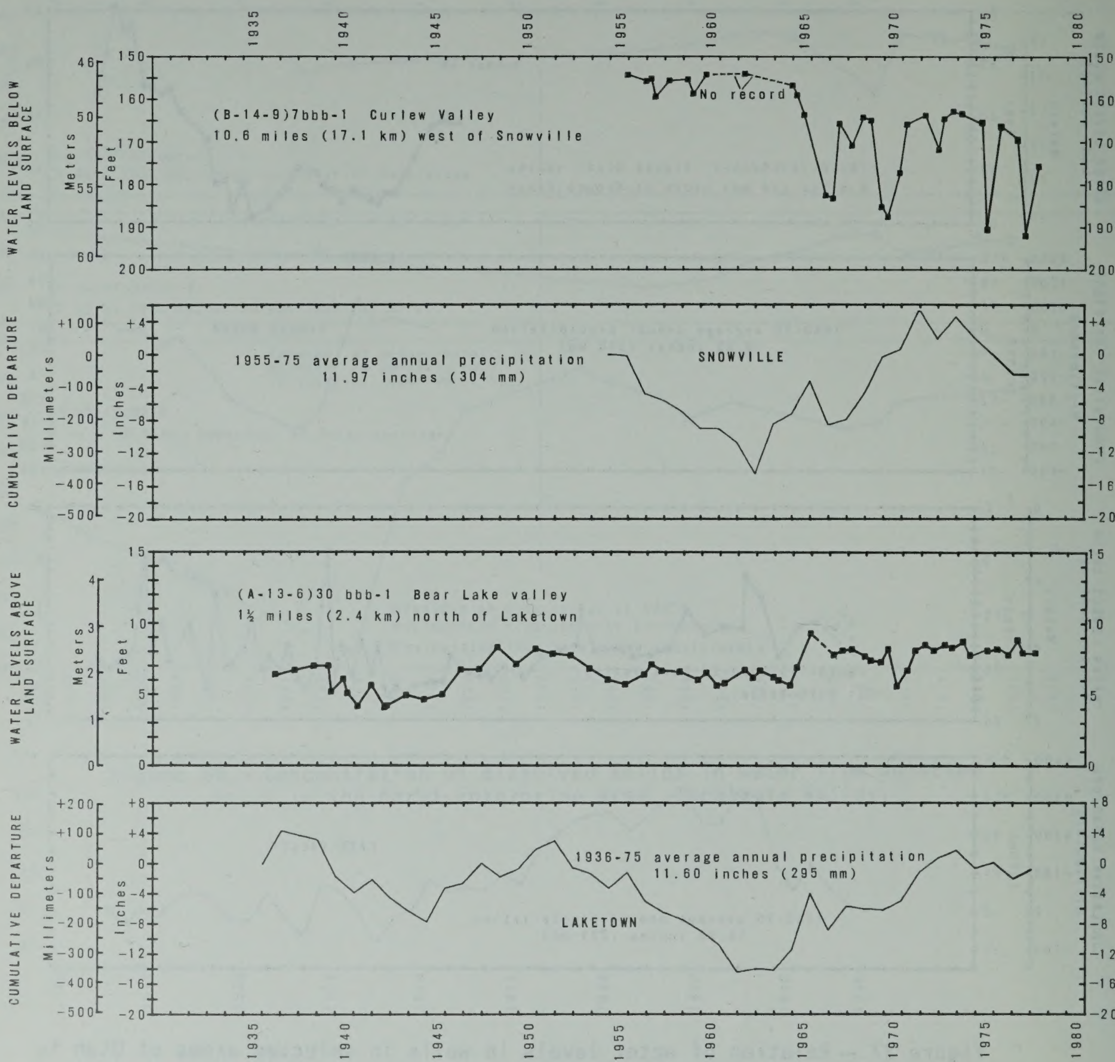

Figure 37.— Continued.

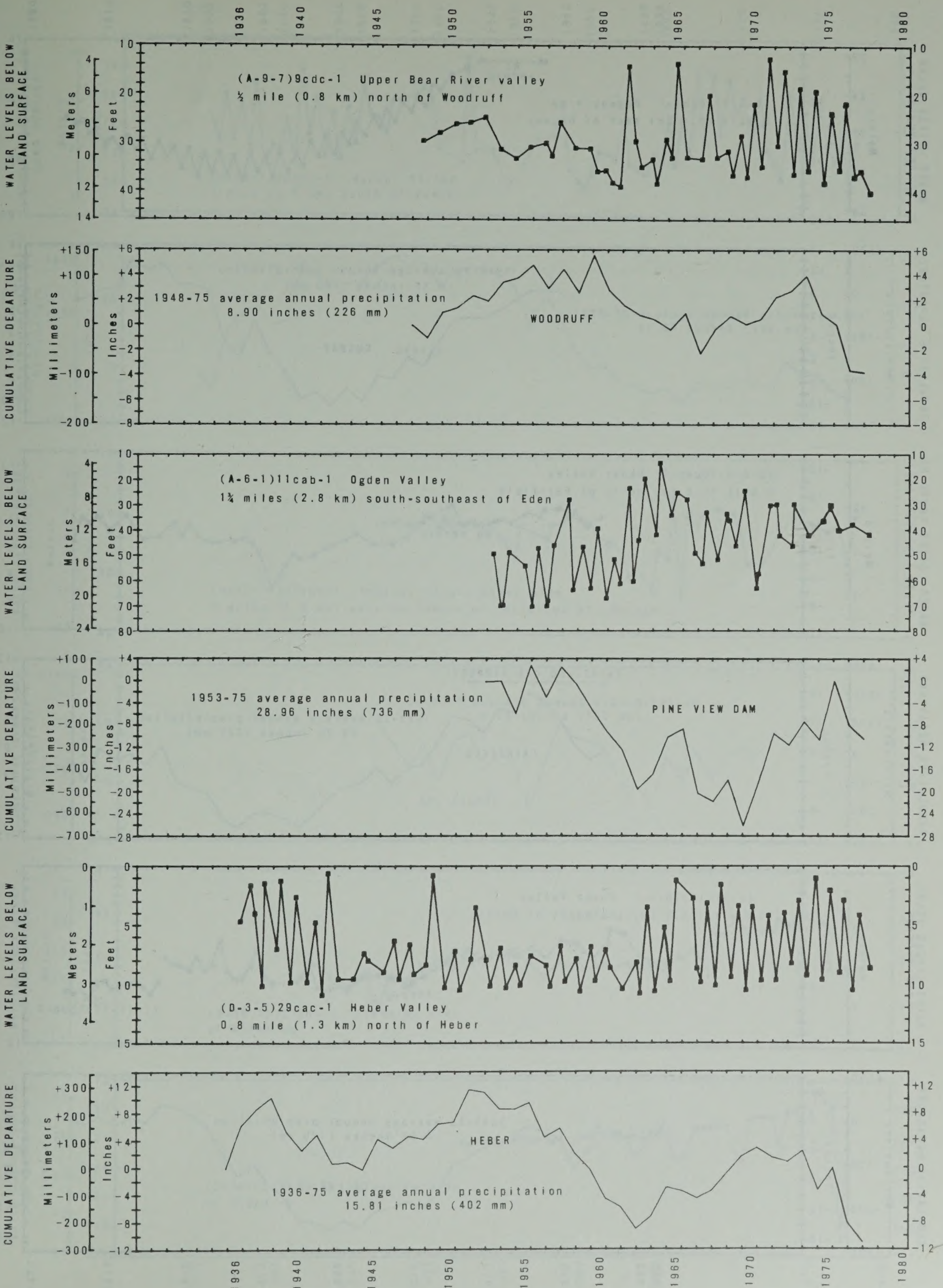

Figure 37.— Continued.

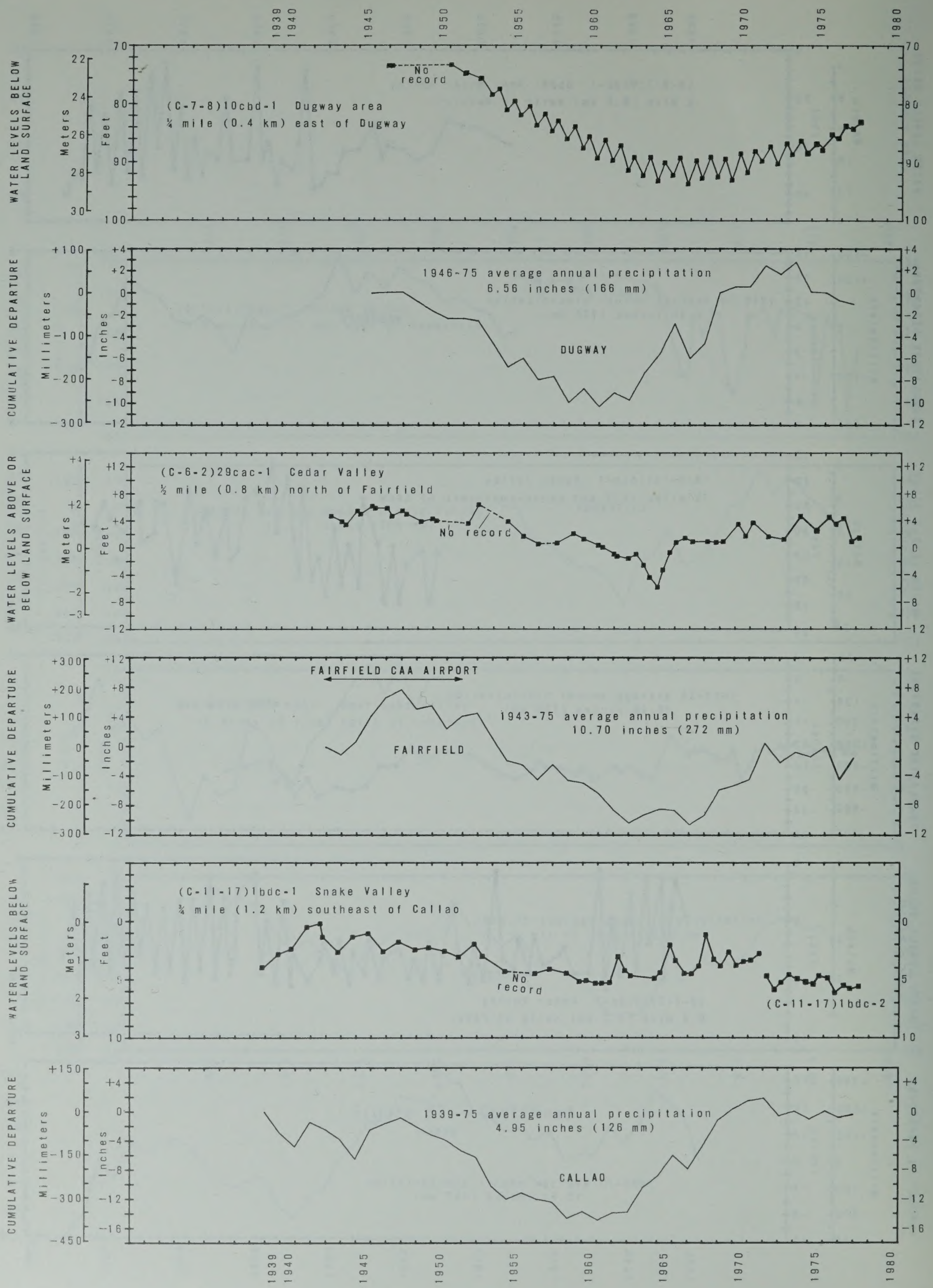

Figure 37.— Continued.

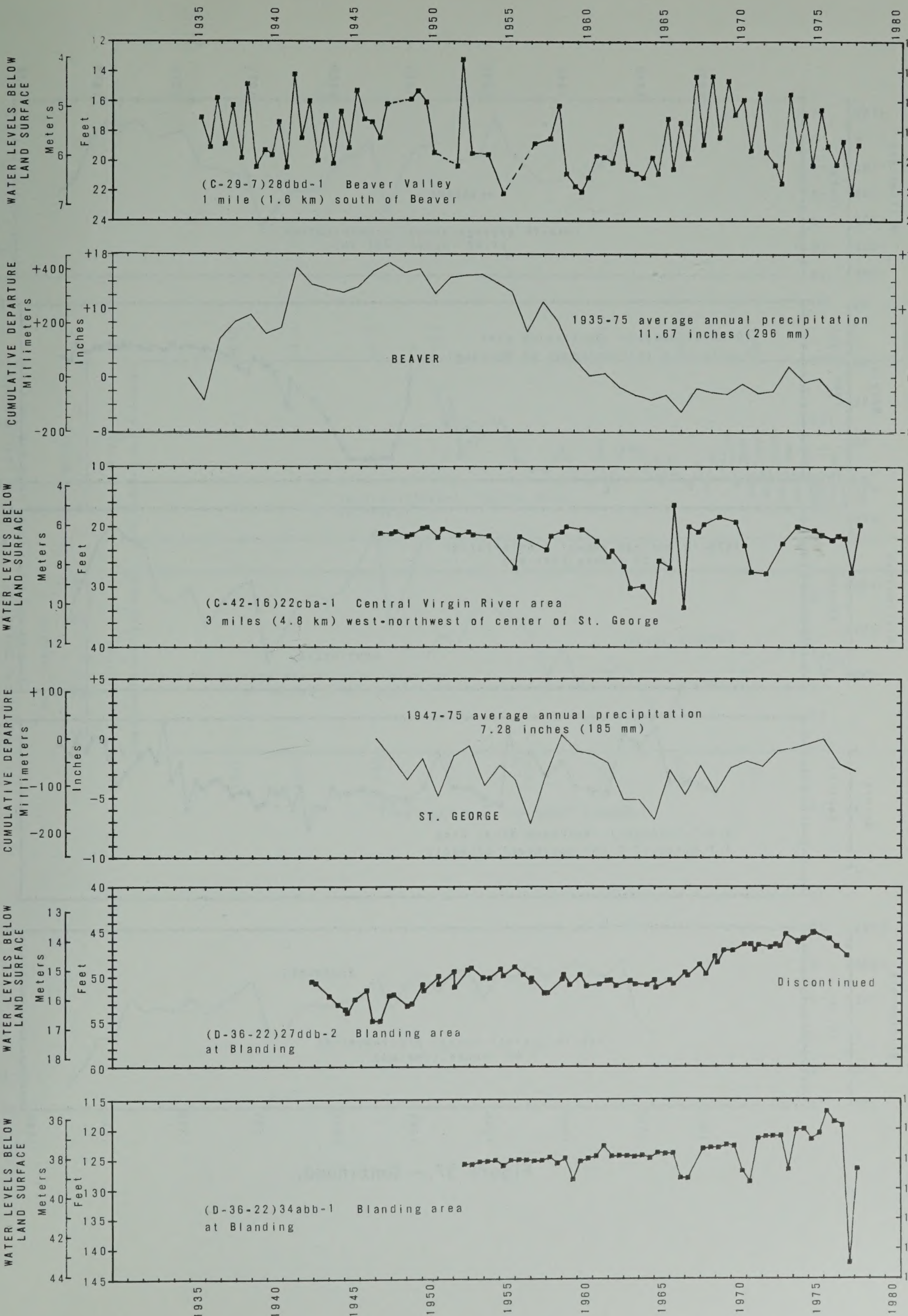

Figure 37.— Continued.

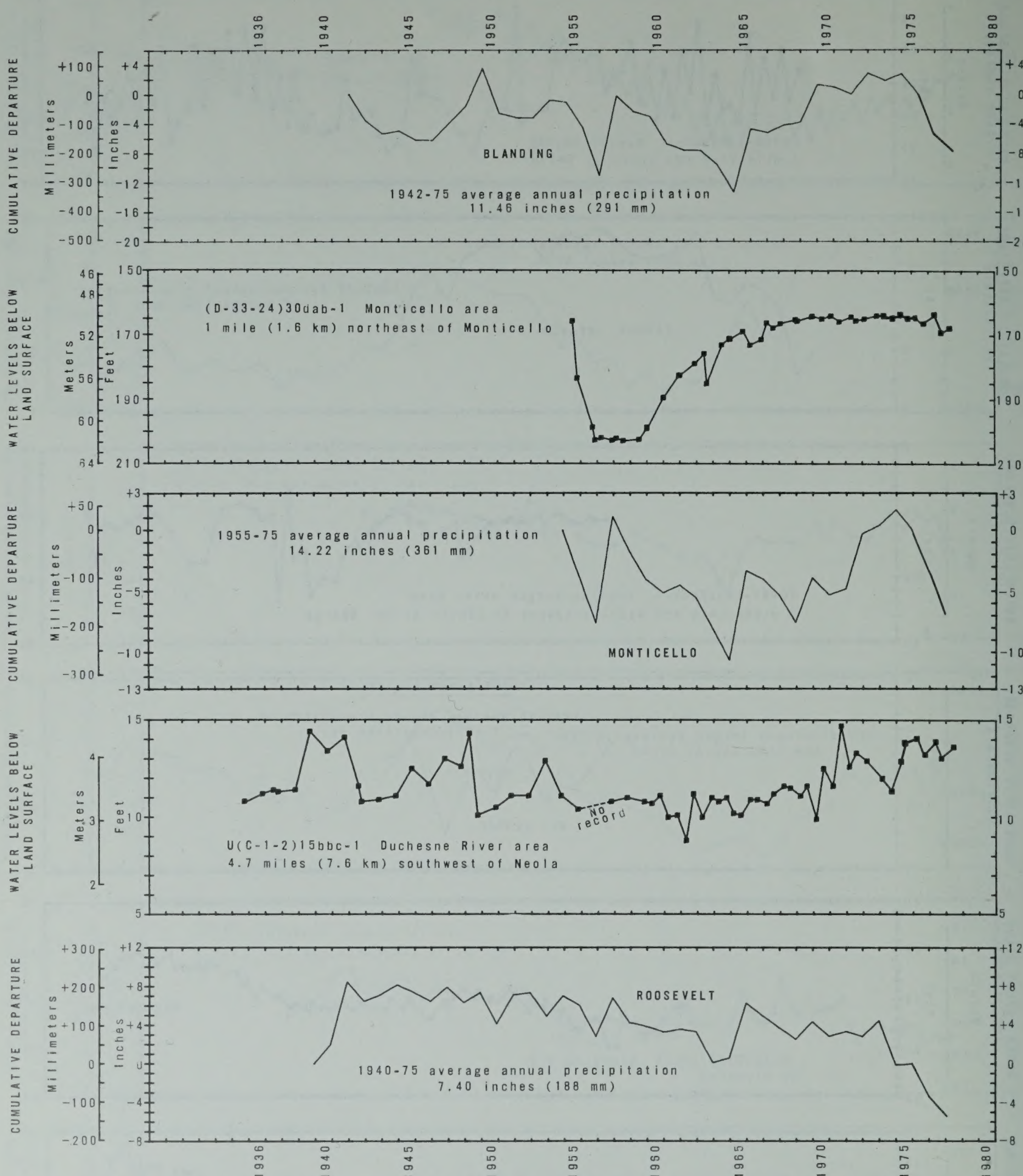

Figure 37.— Continued.

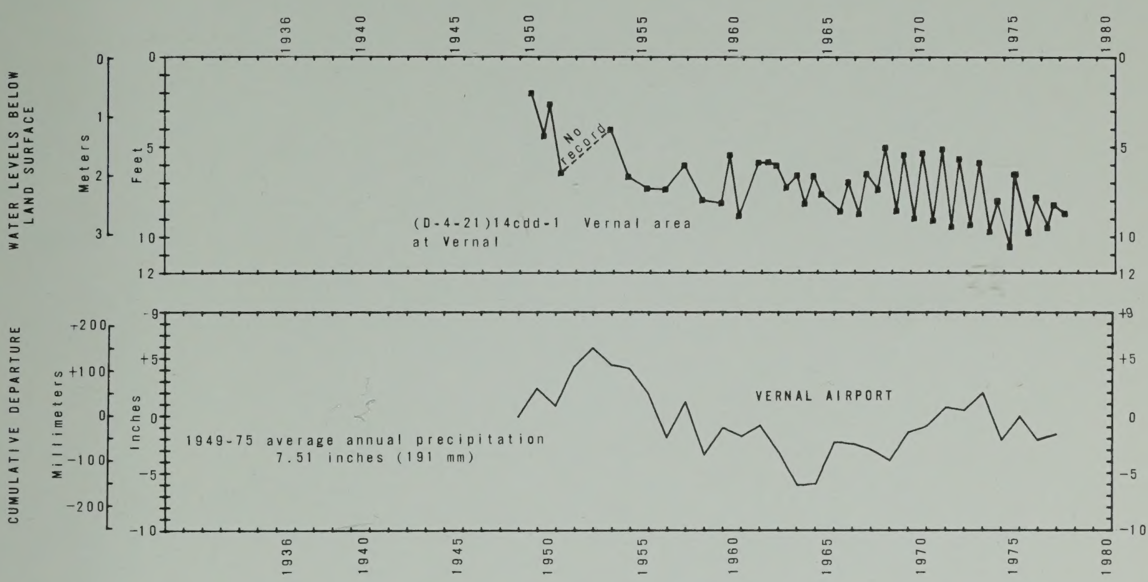

Figure 37.— Continued.